Design Plan

Former Speiss-Dross Plant Area Slurry Wall

Asarco Smelter Facility
East Helena, MT

Shaw E&I Project No. 125406

April 2007

Shaw™ Shaw E & I

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APPENDICES

ACRONYMS AND ABBREVIATIONS

Asarco	ASARCO, LLC
bgs	below ground surface
CAMU	Corrective Action Management Unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm/sec	centimeter per second
CQCP	Construction Quality Control Plan
EPA	Environmental Protection Agency
RCRA	Resource Conservation Recovery Act
SB	soil-bentonite
SBC	soil-bentonite-cement
Shaw	Shaw Environmental & Infrastructure, Inc.

DESIGN
SLURRY WALL AT THE FORMER SPEISS-DROSS PLANT AREA

1.0 INTRODUCTION

This Design Plan has been prepared for ASARCO, LLC (Asarco) for the design of a slurry wall at the Asarco smelter facility located in East Helena, Montana. Shaw Environmental & Infrastructure, Inc. (Shaw) prepared this document.

The goal of this project is to construct a slurry cut-off wall to encompass the former Speiss-Dross Plant area then construct a temporary cap over the encompassed slurry wall area. Subsurface sediments and groundwater underlying the former Speiss-Dross Plant area encompassed by the wall have been identified as a primary source of arsenic contamination in down-gradient groundwater. The dimensions of the slurry wall will be approximately 1,350 feet in length, 35 to 45 feet in depth, and 3 feet thick. Drawing 1 shows the general plan and layout of the slurry wall. The slurry backfill mixture will consist of a proportioned mixture of excavated and screened in-situ soil, borrow soils from the onsite borrow area, and bentonite generally identified as soil-bentonite (SB) backfill mixture. The slurry wall will be constructed as a continuous wall of SB materials.

1.1 SITE DESCRIPTION

as IM under Federal RD

The Asarco smelter facility includes a lead smelter that operated from 1888 until 2001, the town of East Helena, several residential subdivisions, and surrounding rural agricultural lands, covering approximately 8.4 square miles near East Helena, Montana. Asarco suspended operations at the plant on April 4, 2001. Public access to the smelter is restricted. The Asarco smelter facility is being addressed by Asarco in cooperation with the Environmental Protection Agency (EPA) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Superfund program and as subject to the provisions of the Resource Conservation and Recovery Act (RCRA). The intended location of the slurry wall is at the former Speiss-Dross Plant area located in the central portion of the Asarco facility (see Drawing 1). A temporary cap was installed over the former Speiss-Dross Plant area in November 2006. The general location of the slurry wall will be around the perimeter of this capped area.

1.2 PLAN LAYOUT

Section 1 introduces the project; Section 2 discusses the design approach of the slurry wall, backfill mixture, and temporary cap; Section 3 discusses the construction approach of the slurry wall and temporary cap; and Section 4 lists the references. The specifications, detailed drawings, temporary cap design, bore hole information, bench scale test results for the slurry backfill mix, Construction Quality Control Plan (CQAP), and drawings showing the existing utilities are contained in the various appendices.

2.0 DESIGN APPROACH

The slurry wall design for the former Speiss-Dross Plant Area follows the same general approach utilized for the design and construction of the slurry wall for the former Acid Plant Sediment Drying Area (October 2006), which included but was not limited to bench scale laboratory studies. Technical specifications and drawings for the slurry wall are located in Appendices A and B, respectively.

The same temporary cap plans and specification established by Hydrometrics, Inc. for the temporary caps that were constructed in November 2006 will be used for the temporary cap at the former Speiss-Dross Plant area. These temporary cap plans and specification are located in Appendix C. The following sections discuss the general design approach for the slurry backfill mix, the trench, and the temporary cap.

2.1 SLURRY BACKFILL MIX DESIGN

The major factors that determine the design specifications for a slurry wall are the types of contaminants present and their associated concentrations, the compatibility of the slurry materials with existing groundwater, and the anticipated permeability of the slurry wall materials.

2.1.1 Design-Phase Investigation

Asarco conducted a site investigation in August and September 2006 to more fully characterize the soil conditions of the proposed slurry wall location. Four soil borings were drilled in the former Speiss-Dross Plant area to determine the depth to volcanic tuff/ash layer; type, composition and limits of various soils within the boring columns; and potential subsurface obstructions. Copies of the soil borings are located in Appendix D.

2.1.2 Bench Scale Laboratory Studies

The initial bench scale laboratory studies were performed in February and March 2007 to design the slurry wall backfill mixture. Shaw, in conjunction with Geo-Solutions, Inc., performed the bench scale tests utilizing field materials provided by Asarco. These field materials included groundwater and soil boring soils from the former Speiss-Dross Plant area, water from city of East Helena (mix water), and borrow soils from the borrow area, which is located south of the Asarco facility near the proposed Corrective Action Management Unit (CAMU) Phase 2 cell.

Two separate bench scale laboratory studies were initiated utilizing SB and soil-bentonite-cement (SBC) mixes. If the compatibility tests proved that the bentonite was compatible with groundwater then a SB slurry mixture would be formulated. The bench scale laboratory study was performed on the SBC mix as a preventative measure to minimize or eliminate design schedule impacts in case the SB mix compatibility tests proved that bentonite was not compatible with groundwater. The following activities were conducted for the studies:

- The initial bench scale laboratory study included:
    - "Index" tests to assess the gross compatibility of commercial clays (bentonite, etc) with site groundwater. The Index tests included (1) Chemical Desiccation, (2) Sedimentation /Flocculation, and (3) Modified Filter Press with Groundwater
    - Two additional Index tests were performed on the SBC mix to further assess the gross compatibility with SBC and groundwater. These Index tests included (1) the Cement Pan Test, and (2) the Slate Test.
    - Based on the Index Tests, it was determined that the SB and SBC were both compatible with the groundwater. Because of its relative lower permeability rates, SB was chosen over SBC as the preferred mix medium. Five SB proportioned mixtures were formulated and tested to determine the optimum mixture for low permeability of water based on site samples and a maximum permeability rate of 1×10^{-7} centimeters per second (cm/sec).

A summary of the bench scales results are included in Appendix E of this document.

2.1.3 Slurry Backfill Mixture

The SB slurry backfill mixture was based on the initial bench scale laboratory studies and previous experience with slurry wall mix designs including one specific to the Asarco East Helena project site. A slurry backfill mix was designed based on a maximum permeability rate of 1×10^{-7} centimeter per second (cm/sec) (anticipated maximum permeability rate based on previous slurry wall designs) as demonstrated by the Index and Permeability tests.

The long-term compatibility/permeability tests of the SB slurry backfill mixture are being performed utilizing site groundwater to better correlate with actual field conditions.

The Index and Permeability tests demonstrated that a slurry backfill mix will require at or about one (1) percent bentonite content to meet or exceed the maximum permeability rate. The slurry wall specifications are located in Appendix A.

2.2 TRENCH DESIGN

Based on the soil borings it is anticipated that the trench will be excavated to depths ranging from a minimum of 35 to 45 feet below ground surface (bgs) "keying" in a minimum of two (2) feet into the existing low permeability volcanic tuff/ash layer. The proposed slurry wall trench layout is shown on Drawing 1 and profiles for each of the four sides are shown on Drawings 2 through 5. The minimum required width of the slurry wall trench will be 3 feet. Specifications for the slurry wall trench are located in Appendix A.

2.3 TEMPORARY CAP DESIGN

The temporary cap design prepared by Hydrometrics, Inc. and previously installed at various locations onsite will be utilized for the (re)installation of the temporary cap at the former Speiss-Dross Plant area. The general location of the temporary cap is shown on Drawing 6 with a cross

section of the temporary cap shown on Drawing 7. Final location of the former Speiss-Dross slurry wall will be determined in the field based on minor relocations required to avoid unforeseen obstacles. The temporary cap design package by Hydrometrics, Inc. is located in Appendix C with the modification that the liner seams will be sewn.

3.0 CONSTRUCTION APPROACH

The following Sections outline the activities anticipated for the construction of the slurry wall at the former Speiss-Dross Plant area. General activities include (1) site preparation, (2) slurry wall construction, (3) temporary cap construction, and (4) site restoration.

Health and safety meetings will be held and documented prior to each work day to ensure worker familiarity with current site conditions. All work will be conducted using the appropriate personal protective equipment. A set of construction specifications and drawings are included in this document. All construction activities shall following the CQCP, which is located in Appendix F. A brief summary of the construction approach is presented in the following sections.

3.1 PRE-CONSTRUCTION SITE ACTIVITIES

3.1.1 Pre-Construction Meeting

Prior to onsite construction activities l, the Contractor will conduct a Pre-Construction Meeting. The Pre-Construction Meeting will be attended by Contractor, subcontractors (as appropriate), Asarco. EPA and Montana Department of Environmental Quality will be invited to the Pre-Construction Meeting.

3.1.2 Permitting and Coordination

The following permits, coordination, and documentation will be acquired and/or completed:

- Compliance with applicable requirements of the Montana Department of Environmental Air Quality Resources Management Bureau for activities that may result in air emissions; and
- Activities that affect utilities (water, electrical, natural gas, sewage, etc.) will be coordinated through Asarco.
- Contractor will obtain any other permits or certificates and pay all fees required for the performance of the work described or required whether stated, implied, or ancillary to successfully complete the project.

3.1.3 Mobilization for Construction Activities

Mobilization of personnel and construction equipment will occur upon written authorization from Asarco.

3.1.4 Site Access and Security

The Contractor will conform to Asarco rules for on-site contractors that include safety, security, and notification procedures and requirements. The rules generally address worker safety, public safety, onsite traffic routes, contractor interaction, security, available water resources, etc. The rules and regulations will be discussed in further detail at the pre-construction meeting and at project status meetings that will be conducted throughout the duration of the project.

The Contractor will control project area access during this project by constructing and implementing security measures sufficient to protect workers from unauthorized access to work areas. The Contractor will be responsible for maintaining his site security while directing construction activities. The normal work hours will be from 7:00 a.m. to 5:00 p.m., Monday through Saturday. The Contractor shall schedule their work and work related activities to fit within the parameters of this schedule. Should an emergency arise that requires longer hours and/or workweeks based on items such as the life cycle of the slurry, schedule status, material deliveries, or other project related activities, the Contractor must provide their request for approval of non-scheduled work hours in writing to Asarco for discussion and potential approval. Asarco has no contractual obligation or commitment to approve any extension or alteration to the normal work schedule parameters. The Contractor assumes all liability associated with any increased cost, schedule impacts, fees, loss of production, etc. that may be result from their inability to appropriately schedule and complete the work within the established normal working hour parameters.

The City of East Helena provides emergency services to the site on an as needed basis. The 911 emergency telephone number is in effect and can be utilized in the event of an emergency. The Contractor is responsible to provide for the health and safety of their employees, subcontractors, onsite vendors, visitors and general public welfare relative to the work being performed and services required to provide a safe work environment. The Contractor must ensure that the 911 number is still in affect prior to mobilizing to the site. All emergency numbers, procedures, and maps will be clearly displayed and readily accessible to all contractor employees, subcontractors, onsite vendors, and visitors.

During the construction of the slurry wall, orange safety fencing, and/or warning signs will be utilized to restrict unauthorized entry into active work areas. Sufficient prior notification (at least 24 hour in advance) regarding these activities will be given to Asarco, as appropriate. In addition, roadway to the Change House building will be kept clear to ensure continuous access by Asarco and other contractors.

3.1.5 Equipment Set-Up Areas

Suitable areas will be selected within the work area where heavy equipment (such as media mixers, excavators, dump trucks, and so on) may be staged during the site preparation and construction activities. Equipment set-up areas will be selected based upon accessibility to a targeted work area. The selected set-up area will not impede access to or traffic flow around specific targeted work areas. An additional contractor "lay down" area will be provided in or about the main parking lot for the storage or offloading of "clean" materials and equipment only.

3.2 SLURRY WALL

3.2.1 Site Preparation

The following items will be completed prior to start of slurry wall excavation:

- The temporary cap currently covering the area will be completely removed.
- The liner will be folded or rolled with the clean side out and placed in storage, if appropriate. The liner will be stored on visqueen, covered with visqueen, and the visqueen secured in place with sand bags.
- The geotextile filter fabric will be hauled to the Ore Storage Building or direct hauled to the CAMU for disposal, as directed by Asarco.
- Slag and fill materials beneath the existing temporary cap will be loaded, transported, and stockpiled in an area determined by Asarco for later re-use.
- A working platform will be constructed in low lying areas to provide a working platform for trench installation.
- Stormwater controls will be installed as appropriate and may include run-on/runoff berms, hay bales, and/or silt fence.
- Temporary construction fence (i.e., orange safety fence) will be placed as necessary.

An area south of the Asarco facility near the proposed CAMU Phase 2 cell has been identified as the onsite borrow area by Asarco. Soil will be excavated from the CAMU area and transported via trucks to the slurry wall construction area. The onsite borrow soil will be used for construction of a work platform, the slurry backfill mix, and berm construction, if needed. Some excess soils may be available from the CAMU Phase 2 cell construction for use as "borrow" soils but will be at the discretion of Asarco whether these soils are available to the Contractor.

3.2.2 Stormwater Runoff Control Measures

Surface water run-off resulting from storm events that occur throughout the site preparation, construction of the slurry wall, and site restoration will be properly managed in compliance with Asarco's Stormwater Pollution Prevention Plan, all local, state, and federal laws, statutes, regulation, and permits applicable to the site and activities being performed onsite.

3.2.3 Demolition and Pre-Excavation Activities

Prior to pre-excavation activities, the Contractor will saw cut the asphalt and/or concrete on both sides of the slurry wall trench to a minimum width of two (2) foot greater than the width of the slurry wall (five [5] total feet minimum width). The asphalt and/or concrete pavement in the trench alignment will be sized to less than two (2) feet in dimension, removed, loaded, hauled, and stockpiled in the Ore Storage Building or direct hauled to the CAMU, as directed by Asarco. Railroad tracks and ties that intersect the alignment of the slurry wall will be removed during the pre-excavation activities. The railroad ties will be removed, cut into sections less than two (2) feet in dimension, loaded, hauled, and stockpiled in the Ore Storage Building or direct hauled to

the CAMU, as directed by Asarco. The metal rails will be removed, cleaned, sized appropriately, and recycled off site at a licensed metal recycling facility.

Utility locates will be performed by the Contractor and compared with the utility drawings and underground utility information provided by Asarco to delineate as many underground utilities as possible prior to pre-excavation activities. Utility maps provided by Asarco/Hydrometrics, Inc. are included in the Appendix G – Utility Drawings.

With the utility locate completed, the entire alignment of the slurry wall will be pre-excavated to a depth of eight (8) feet below ground surface (bgs) to locate, sever, remove, pressure grout, and cap all underground lines/utilities that intersect the slurry wall to eliminate the potential for slurry or other materials to migrate off site. All existing underground utilities (including but not limited to piping, conduits, catch basins, manholes, etc.) will be plugged/capped and abandoned in place along their entirety utilizing flowable fill or other approved material. The Contractor may opt to increase the width of the pavement cut and lay back the sides of the pre-excavation trench in order to meet OSHA standards. Currently fifteen utility locations have been identified where the underground line will intersect the trench. Soils, small cobbles, and small debris excavated from the trench will be temporarily stockpiled adjacent to and inside the trench alignment (i.e., within the perimeter of the slurry wall) for future use or placement under the temporary cap upon completion of the slurry wall. Materials excavated from the trench are considered contaminated and at no time will any excavated material, debris, cobbles, groundwater, etc. be permitted to be stockpiled, placed, or "leach" outside the alignment of the trench.

Since the utility piping were previously flushed with water and blown out with air, the Contractor should anticipate that some utilities/piping may contain some residual material (e.g., plant water, residual pipe sediments, sewage) from previous activities and take the necessary precautions to protect worker and the public safety while complying with applicable regulation for the handling of unknown materials. Asarco will be responsible for disposal of potential residual in the utilities.

3.2.4 General Excavation Procedures

The objective of this task is to excavate soil from the trench alignment where the slurry wall will be constructed to the depth required and "keying" into the existing low permeability ash layer. All excavation work will be performed in accordance with applicable federal, state, and local regulations. Excavation of the slurry wall trench will be performed primarily using a long stick excavator working through and under the slurry. It will not be possible to observe the groundwater or trench bottom during the excavation due to the presence of the groundwater and the slurry backfill mix in the trench. De-watering equipment will not be necessary during the installation of the slurry wall.

It is anticipated that the trench will be excavated with a long stick excavator equipped with a 3 foot wide bucket. The 3 foot plan width of the trench will be achieved by excavating the soil to a width of at least one bucket. The excavator will remove the soils and place the excavated soil into a non-screen backfill stockpile or on a vibrating screen for removal of cobbles and oversize

debris. The screen will segregate unsuitable material (spoils) from usable backfill soil. Unsuitable spoils will be stockpiled on site while suitable excavated soils will be utilized in the slurry backfill mix. Stockpiles and processing of all excavated soils, spoils, debris, etc. will be performed within the limits of the slurry wall alignment so potentially contaminated materials or liquids are kept within the alignment of the slurry wall.

Measurements below the slurry level will be made with a sounding cable. A sounding cable is a special surveyor's tape with a weight attached to the end (similar to a large plumb bob) so that the depth can be measured from the surface to the bottom of the trench. Experienced personnel can determine the depth to the bottom and certain features of the bottom (e.g., the presence of boulders) by feeling with the sounding cable.

3.2.4.1 Trench Construction

The trench will be supported with bentonite slurry and backfilled with the SB slurry backfill mixture. After the excavation of a portion of the slurry trench, the slurry backfill mixture will be mixed in the appropriate proportions and placed into the trench displacing the slurry into subsequent excavations.

The Contractor will provide sufficient numbers and types of excavating equipment to complete the slurry wall trench to the final depth and complete the project within the given schedule. The equipment will be in good working condition with no hydraulic/oil leaks or unsafe conditions. This heavy equipment will have been decontaminated prior to mobilization to the work site. The plant for mixing the slurry will include the necessary equipment to provide a homogeneous slurry material appropriate for the construction of the former Speiss-Dross slurry wall.

The Contractor will maintain the stability of the trench excavation at all times. This will be accomplished by the Contractor through the use of the methods and process available that include but are not limited to the slurry and by controlling the surcharge (weight) associated with live and dead loads, including but are not limited to excavation and backfill equipment, soil stockpiles and backfill stockpiles. The amount and quality of the slurry in the trench will be maintained at a level sufficient to maintain trench stability, but generally the trench will be full of slurry at all times.

The Contractor will have sufficient personnel and equipment ready during construction and on-call during nights and weekends to effectively and efficiently perform the work and respond to any emergency situation that may arise. The quality of the slurry will be maintained by the Contractor at all times until the SB backfill mixture is in place.

The following tolerances will apply to the slurry wall trench dimensions and installation. The slurry wall trench walls will be essentially vertical. The working platform and/or excavating equipment will be leveled to be plumb to the greatest extent possible.

Construction activities will not be permitted when weather conditions may compromise worker safety or the quality of the work.

After the plan trench depth is achieved, the depth will be measured by sounding on 10 foot horizontal intervals for the entire length of the slurry wall. The bottom of the trench may be cleaned repeatedly and re-measured until the plan depth and width are assured.

3.2.4.2 Excavated Soils

Excavated materials will be segregated into at least two separate stockpiles; the first stockpile will contain soils suitable for utilization in the slurry backfill mix directly from the excavation. The second stockpile will contain soils mixed with rock and unsuitable material (spoils) that cannot be directly utilized in the slurry backfill mix. The excavated spoils materials will be stockpiled onsite in the general vicinity of the work area inside the slurry wall foot print and screened utilizing a powered screen to separate suitable soils from unsuitable spoils. The suitable soils will be stockpiled for utilization in the slurry backfill mix while the spoils will be stockpiled in a separate stockpile for final placement within the slurry wall alignment and beneath the temporary cap. All stockpiles will be constructed and maintained within the limits of the slurry wall alignment.

As necessary due to inclement weather (rain, snow, high winds), the stockpiles will be cover with six (6) mil visqueen and anchored in place with sand bags. Upon completion of the slurry wall all "remote" stockpiles of rocks and spoils will be mixed with excess slurry as described in Section 3.2.5.

3.2.5 Waste Management

The waste streams anticipated during the course of the slurry wall construction include but are not limited to residuals from the utilities, excavated soils (spoils), excess slurry mixture, excess slurry backfill mixture, work platform materials, and minimal excess borrow material. The Contractor will collect and contain any residuals from the utilities and Asarco will be responsible for disposal. During slurry wall construction, stockpiles(s) of excavated spoils unsuitable for backfill slurry mix will remain within the alignment of the slurry wall. Excavated spoils will be stockpiled away from the slurry trench but within the slurry wall alignment. Excess slurry will be placed onsite inside the slurry wall footprint (i.e., within the perimeter of the slurry wall) in the former Speiss-Dross Plant area and mixed with available "dryer" soils. The excavated spoil stockpiles as well as any extra soil, work platform soils, and excess borrow soils will be incorporated under the former Speiss-Dross Plant area temporary cap after slurry wall construction is completed. It is anticipated that the spoils along with any remaining materials from the construction of the slurry wall will be of insufficient strength to provide the subgrade required for installation of the temporary cap. The Contractor will be required to solidify the material to a consistency sufficient for grading and provide a suitable subgrade for placement of the temporary liner inclusive of sufficient subgrade strength to bear the weight of a human without impacting subgrade integrity or suitability.

<u>Spoils and Excess Slurry</u> – At the completion of backfilling the slurry wall, excess slurry, excess soil, and the spoils will be handled in the following steps:

- The soil used for the working platform will be placed inside the slurry wall footprint.
- The excess slurry mixture will be placed inside the slurry wall footprint in the middle of the former Speiss-Dross Plant area and mixed with available "dryer" spoils and any excess soil.
- The excess slurry-spoils-soils mix will require solidification prior to construction of the temporary cap subgrade. "Solidification" will use a sufficient quantify of cement to solidify the excess slurry-spoils-soils mix without creating a huge mass or monolith of cement/concrete.
- The solidified slurry-spoils-soils will be graded within the slurry wall footprint to create positive drainage away from the slurry wall in the direction as generally shown on the drawings.

3.2.6 Inspection and Decontamination of Heavy Equipment

The Contractor will inspect transport vehicles (dump trucks) for structural integrity and regulatory compliance, as appropriate. Structural integrity concerns may include holes or cracks in floors and/or walls, liners and/or tarps, previous contamination, and excessive oxidation (rusting). Other heavy equipment such as slurry mixers, excavators, and bulldozers arriving at the slurry wall work site for the first time will have already been decontaminated prior to their arrival.

Gross decontamination of equipment will be performed whenever leaving the designated work area. Gross decontamination will focus on minimizing the spread of excavated soil as a result of equipment movement and transport. This decontamination process shall use dry methods (brooms, wipes, shovels, etc.) within the work zone in order to remove large, easy dislodged deposits of soil and/or other contaminated media prior to exiting the work zone.

Final decontamination of heavy equipment will be implemented at the Asarco truck wash. The Contractor will receive instructions by Asarco on how and when to use the truck wash facility. Contractor's use of the truck wash facility can only be accomplished once gross decontamination of the equipment has been performed.

3.2.7 Control of Fugitive Emissions

Fugitive emission control measures will be implemented beginning with the mobilization of equipment, materials, and manpower, and will continue during all phases of fieldwork. Air emissions from dust in the air will be controlled by spraying the surface of the area to be excavated with water or with a dust-suppressing agent, if required. Dust suppression agents other than water must be approved by Asarco in writing prior to mobilization or application of any agents.

In general, slurry trenching creates only a minor potential for dusting because of the use of liquid slurry, which provides an engineering control. If conditions require specialized controls, the Contractor will re-evaluate site conditions and propose corrective actions.

3.2.8 Inspection and Maintenance of the Work Site

Inspection and maintenance practices will be conducted on a regular basis to maintain the silt sediments and surface water controls. Inspections and maintenance will occur weekly and within 24 hours of an event.

3.2.9 Slurry Backfill Mix

The specification for the slurry backfill mix is included in Appendix A of this document. Guidelines for placement procedures and quality assurance/quality control testing have also been provided.

The slurry mixture will be mixed on site using the following criteria and components:

- Production/mix water will be obtained from the city of East Helena via an onsite water hydrant.
- Onsite borrow soil will be utilized in the slurry backfill mix to compensate for anticipated lack of fines in the in-situ Speiss-Dross materials required for slurry backfill mix.
- Fifty percent or more of the excavated material is assumed to be unsuitable for the slurry backfill mix.
- The area south of the Asarco facility near the proposed CAMU Phase 2 cell has been identified by Asarco as the onsite clean borrow source.
- The slurry backfill mix design will specify percentages of bentonite, screened in-situ material, borrow material, and/or cement, if required, to be utilized in the slurry backfill mix as determined by calculating the volume and weight of the in-situ soils in a given length of trench and from the mix design calculating the bentonite required and "adding" the necessary number of "bulk bags" of bentonite to that given length of trench.
- Quality control of the slurry backfill mix will document that the correct percentage of bentonite, screened in-situ material, borrow material and cement, if required, is utilized in the slurry backfill mix. During the backfilling of the trench, backfill slurry mix will be collected from the excavator's bucket to test for quality control by documenting the backfill slump and unit weight.
- A mixing circuit for the slurry will be established within or adjacent to the work area.
- Slurry activities will be confined to the general former Speiss-Dross Plant area as other contractors will be working onsite.

3.2.10 Backfill Procedures

The SB backfill slurry material will be mixed on site so that the mixture appears homogenous and the proper consistency is reached. The prepared material will then placed into the trench at the point where backfill rises to the ground surface, thus avoiding segregation that might be caused by free dropping through the slurry. The slope of the backfill advances by a combination of mud wave and sliding down the face of the previously placed backfill. Ideally, the backfill should not be so stiff that a steep slope will form below the slurry surface, risking the possibility

of folding and trapping pockets of slurry within the backfill, nor should it be so fluid that segregation might occur during placement.

3.2.11 Groundwater Management

The objective of this activity is to manage groundwater that will be encountered during the construction of the slurry wall. Although the wall excavation will take place below the existing water table no supplemental dewatering measures such as pumping will be used to control groundwater during construction. The slurry will hold the trench open and will preclude the use of any measures, other than the slurry, to manage the groundwater.

3.3 TEMPORARY CAP

The temporary cap will be installed and/or re-installed over the newly graded area and will be extended as necessary to encompass the entire slurry wall footprint as indicated on the drawings. At no time will the edge of the temporary cap be less than five (5) feet beyond the outside edge of the slurry wall. Drawing 6 shows the location of the temporary cap. The temporary cap will tie into the existing Sinter Plant temporary cap and tie into to temporary caps to the south, and east (as depicted on Hydrometrics' Drawing 15, which is located in Appendix C of this document) which will be constructed by others, if those temporary caps exist at the time of construction. Twelve wells (eleven [11] monitoring wells and one [1] test well) will be extended a minimum of two (2) feet to above the temporary cap. The extended wells will be surveyed to determine the new casing elevation. The temporary cap will be constructed to the surface water drainage flow pattern established in the demolition design and as depicted on Hydrometrics' Drawing 16, which is located in Appendix C of this document.

3.4 DEMOBILIZATION AND SITE RESTORATION

Upon completion of slurry wall and temporary cap construction activities, heavy equipment will be decontaminated and demobilized from the project site. All materials and supplies will be removed from the site. Installation equipment will be brushed off and washed, as necessary, to remove all soil or debris from the equipment before removal from the site. Temporary facilities (e.g., field office, port-a-johns, and so on) and signs erected during this work will be removed. All stormwater controls and the construction fence will be removed.

All debris and trash will also be placed in Asarco-provided dumpsters. Pre-final and final inspections will be conducted to ensure that the site is returned to contractual conditions. Asarco will sign-off on the final inspection to concur that the site was returned to contractual conditions.

4.0 FINAL REPORT

Following completion of the slurry wall and temporary cap construction, a Final Report will be generated and submitted to Asarco. At a minimum, this report shall document the following:

- Documentation of the slurry wall and temporary cap construction, including topographic survey of area and survey of the extended monitoring wells;

- A summary of the evaluation of the alternatives that led to the selection of the slurry wall remedy will be provided by Asarco for inclusion in the Final Report;
- Copies of the Daily Logs;
- Copies of quality control documentation including laboratory permeability testing reports, and
- A statement that the work was completely substantially in accordance with the Contract Documents.

5.0 REFERENCES

Asarco, Inc. 1994. *East Helena Plant. Safety Orientation for Contractors*. March 1994.

APPENDIX A

SPECIFICATIONS

List of Specifications

Monitoring Wells
Pre-Excavation and Underground Pipelines
Site Preparation
Soil-Bentonite Slurry Wall
Submittals

MONITORING WELLS

PART 1 GENERAL

1.1 PROTECTION

All monitoring wells shall be protected at all times and shall not be damaged during any site activities including but not limited to mobilization, site preparation, pre-excavation activities, slurry wall construction, and temporary cap construction activities. Contractor shall be responsible to reimburse the Owner for any and all costs associated with well replacement should well replacement be necessary due to Contractor activities.

1.2 EXTENSION

1.2.1 Extend twelve (12) wells (eleven [11] monitoring wells and one [1] test well) that are located in the capped area above the final temporary cap. The wells shall be extended a minimum of two (2) feet to above the final temporary cap.

1.2.2 Contractor shall verify size and type of well for extension.

1.2.3 All well extensions and completions shall be vertical (plumb) and maintain the integrity of the existing interior PVC casing and exterior casing. All well extensions shall be done by a Montana licensed monitoring well contractor in accordance with Montana Department of Natural Resources and Conservation (MDNRC) monitoring well construction requirements.

1.2.4 See details on well extension in Section VI – Design Plan, Appendix C, Sheet 22.

1.2.5 Completed, extended wells shall be surveyed by a Montana licensed surveyor to determine the new casing elevation and location.

END OF SECTION

PRE-EXCAVATION TRENCHING AND UNDERGROUND UTILITIES

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Supply all materials, equipment, and labor required to pre-excavate the entire alignment of the slurry wall to a depth of eight (8) feet to locate, plug, and abandoned in place all underground piping and utilities that intersect the slurry wall to eliminate the potential for slurry or other materials to migrate off site or into the slurry backfill mixture. Plug piping larger than 12 inches with flowable fill where possible. Use pressure grouting for all other piping. Flush all conduits with water and blow them out with compressed air. All pavement (asphalt and concrete), concrete pads, and railroad tracks located in the trench alignment shall be removed, loaded, transported, and stockpiled in the Ore Storage Building or direct hauled to the CAMU, as directed by the Owner.

1.1.2 Supply all materials, equipment, supervision, and labor required to backfill the pre-excavated trench prior to start of the slurry wall excavation.

1.1.3 See Specification Section – Site Preparation for details for complete removal of the existing temporary cap and construction of the working platform.

1.2 UNDERGROUND UTILITIES

The following four types of underground lines were identified that will be of potential interest when excavating the slurry wall.

- Process Water Lines (PW) – abandoned, previously pressurized, potentially five (5) locations.
- Process Return Water (PRW) –abandoned, previously flushed, gravity flow, manholes in system, potentially five (5) locations.
- City Water (CW) – stub out lines to remote buildings, shutoff available, potentially three (3) locations.
- Sewer lines (S) – abandoned, manholes available in system, potentially two (2) locations.

The Contractor shall anticipate that other underground utilities than those identified may be encountered during the pre-excavation of the slurry wall trench. Underground utilities may contain some residual materials (e.g., plant water, residual pipe sediments, and sewage) and the Contractor shall be responsible for controlling and containing any liquids discharged from the severed utilities, protection of workers, and general public safety and welfare. The sewer lines in the slurry wall area were constructed in 1984 and were in good free flowing condition when Asarco discontinued using them in August of 2003. Any potential residual sludge in the sewer lines is expected to be a very minor quantity.

1.3 DUST CONTROL

The Contractor shall comply with applicable air pollution control requirements of federal, state or local regulations. The Contractor shall take appropriate actions to minimize atmospheric pollution. To minimize atmospheric pollution, the Owner shall have the authority to require that reasonable precautions be taken to prevent particulate matter from becoming airborne. Such reasonable precautions shall include, but not be limited to:

1. The use of water or chemicals for control of dusts in excavation activities.
2. Covering, at all times when in motion, open-bodied trucks transporting materials likely to give rise to airborne dusts.

1.4 PROTECTION AND SAFETY

1.4.1 Open Excavations

Provide barricades and/or other safety equipment as required to protect any equipment, vehicles and workers from any open excavation.

1.4.2 Protection of Property

The Contractor shall protect adjacent property and avoid damage to such property. Adjacent property damaged due to the Contractor's operations shall be repaired or replaced at Contractor's expense. The repairs and/or replacement shall be equal to existing improvements and shall match existing finish and dimensions.

1.5 PERMITTING AND COORDINATION

1.5.1 Compliance with applicable requirements of the Montana Department of Environmental Air Quality Resources Management Bureau for activities that may result in air emissions.

1.5.2 Activities that affect utilities (water, electrical, natural gas, sewage, etc.) shall be coordinated through Asarco.

1.5.3 Contractor shall obtain any other permits or certificates and pay all fees required for the performance of the work described or required whether stated, implied, or ancillary to successfully complete the project.

1.5.4 The Contractor is responsible for obtaining off-site utility locations as required by law.

PART 2 MATERIALS

2.1 FLOWABLE FILL

This section covers furnishing and placing of flowable fill. Flowable fill shall be placed in utilities as specified on drawings.

Control Density Fill - (CDF) is used as a low strength, self consolidating fill material for confined spaces that can be easily excavated at a later time. CDF is characterized by a high maximum slump of 8 inches. CDF is not a structural concrete and should not be used in such applications. CDF may be used as a trench backfill, structural backfill, pipe bedding, or pipe filling for abandonment in place. CDF shall consist of Portland cement, aggregates, water and fly ash. Chemical admixtures and other mineral admixtures may be used. The actual mix proportions and flow characteristics shall be determined by the producer of the CDF to meet site conditions. Mix designs, chemical admixtures, mineral admixtures, and performance tests shall be submitted to the Owner for approval.

2.1.1 Portland Cement

Portland cement shall conform to the requirements of ASTM C150, Type I or Type II.

2.1.2 Aggregates

The aggregates shall conform to the requirements of ASTM C33. The amount of material passing the #200 sieve shall not exceed 15 percent. Also, liquid limit and plasticity index shall not exceed 25 and 5, respectively.

2.1.3 Chemical Admixtures

Chemical admixtures shall conform to the requirements of ASTM C494.

2.1.4 Water

Water shall be free of oils, acids, alkalis, organic matter or other deleterious substances.

2.1.5 Fly Ash

Fly ash shall conform to the requirements of ASTM C618, Class C or F.

The Contractor shall perform occasional quality assurance tests on the flowable fill consisting of casting three cylinders for comprehensive strength testing. The required minimum compressive strength value at 28 day age is 200 psi. Compressive strength test specimens are to be cast according to ASTM C31, and tested according to ASTM C39.

The Contractor shall provide the Owner with a mix design from a testing laboratory generally conforming to the requirements of ASTM E329 within 15 days after Notice to Proceed. Mix design strengths at 7 and 14 days shall also be reported within 3 days after the test is performed.

2.1 SATISFACTORY SOIL

Satisfactory soil shall be soil materials free of debris, waste, frozen materials, clay, rock, gravel, or other deleterious matter larger than 3 inches in any dimension.

PART 3 EXECUTION

3.1 UTILITY LOCATE

Utility locates shall be performed by the Contractor and compared with the utility drawings and underground utility information provided by the Owner to delineate as many underground utilities as possible prior to pre-excavation activities. Utility maps provided by the Owner are included in the Appendix G – Utility Drawings.

3.2 PRE-EXCAVATION TRENCH

Prior to pre-excavation activities, the Contractor shall saw cut the asphalt and/or concrete on both sides of the slurry wall trench alignment to a minimum width of two (2) feet greater than the width of the slurry wall (five [5] total feet minimum width). The concrete may contain reinforcing bars. The asphalt and/or concrete pavement in the trench alignment shall be sized to less than two (2) feet in dimension, removed, loaded, transported, and stockpiled in the Ore Storage Building or direct hauled to the CAMU, as directed by Asarco. Any large debris and large cobbles encountered shall also be sized, loaded, transported, and stockpiled in the Ore Storage Building or direct hauled to the CAMU as directed by the Owner.

In addition, railroad tracks inclusive of ties and other apertures that intersect the alignment of the slurry wall shall be removed prior to or during the pre-excavation activities. The length of the tracks to be removed shall be a minimum five (5) feet beyond where the asphalt and/or concrete are to be removed for the slurry wall alignment or the next track rail joint. The railroad ties shall be removed, cut into sections less than two (2) feet in dimension, loaded, hauled, and stockpiled in the Ore Storage Building or direct hauled to the CAMU, as directed by the Owner. The metal rails shall be removed, cleaned, sized appropriately, and recycled off site at a licensed metal recycling facility.

Excavation shall be performed along the entire alignment of the slurry wall trench. See Section VI, Design Plan; Appendix A Specifications – Site Preparation for details on the construction of the working platform. The pre-excavation trench shall be excavated to a minimum depth of eight (8) feet and a minimum width of three (3) feet. The Contractor may opt to increase the width of the pavement cut and lay back the sides of the pre-excavation trench in order to meet OSHA standards.

Soils, small cobbles, and small debris excavated from the trench shall be temporarily stockpiled adjacent to and inside the trench alignment for future use or placement under the temporary cap upon completion of the slurry wall. Materials excavated from the trench are considered

contaminated and at no time shall any excavated material, debris, cobbles, groundwater, etc. be permitted to be stockpiled, placed, or "leach" outside the alignment of the trench.

3.3 PLUG AND ABANDON UNDERGROUND PIPING

All underground piping/utilities located within the slurry wall trench alignment shall be plugged and abandoned prior to backfilling the pre-excavated trench. Plug piping larger than 12 inches with flowable fill where possible. Use pressure grouting for all other piping. Flush all conduits with water and blow them out with compressed air prior to filling or grouting operations. Rinsate must be controlled and captured for proper treatment and/or onsite disposal as directed by the Owner.

Pipe Segments – Designated pipe segments, which include manholes and vaults, shall be plugged with Flowable Fill. Plugging shall begin at the down gradient location, such as a manhole or small vault, and proceed up gradient to ensure effective filling of the conduit.

3.3.1 General Requirements – Flowable Fill

Plug and abandonment of the site underground utilities shall occur with pre-excavation activities and shall be completed before backfilling the pre-excavated trench. Plug piping larger than 12 inches with flowable fill where possible. In addition, the Plant Return Water (PRW) lines, as shown in Section VI, Design Plan; Appendix G – Utility Drawings, shall be flow filled. The PRW lines vary in size. Flush all conduits with water and blow them out with compressed air.

Comply with ASTM C94 for Measuring, Mixing, Transporting, and Placing the Flowable Fill, and as herein specified.

Mix and place Flowable Fill only when the air temperature is at least 35 degrees F and rising. At the time of placement, Flowable Fill shall be at least 40 degrees F. Stop mixing and placement when the air temperature is 40 degrees and falling.

Flowable Fill shall be placed by methods that preserve the quality of the material in terms of compressive strength, flow, homogeneity, plasticity and workability. The material shall be transported, placed, and/or consolidated so that it flows easily through all utility corridors and pipes. It shall have the flow, consistency, and workability such that the material is self-compacting.

Protect freshly placed Flowable Fill from premature drying, excessive cold, or hot temperatures. The air in contact with the backfill surface shall be maintained at temperatures above freezing.

3.3.2 – General Requirements – Pressure Grouting

Plug and abandon underground piping. Plug piping smaller than 12 inches using pressure grouting. Flush all conduits with water and blow them out with compressed air prior to filling or

grouting operations. Rinsate must be controlled and captured for proper treatment and/or onsite disposal as directed by the Owner.

Once cleaned, pressure-grout the piping using a pressure not exceeding 100 psi (690 kPa). Continue grouting until a steady flow of grout exits from the pipe outlet. Seal the outlet, then the inlet with the grout under pressure. Maintain the final grout pressure at between 50 to 100 psi (345 to 590 kPa). The actual mix proportions and flow characteristics for the grout shall be determined by the producer of the grout to meet site conditions. Mix designs, chemical admixtures, mineral admixtures, and performance tests shall be submitted to the Owner for approval.

3.4 BACKFILL

Upon completion of plugging and abandonment of underground pipeline, the pre-excavated trench shall be backfilled with satisfactory soil.

3.5 INSPECTION AND DECONTAMINATION OF HEAVY EQUIPMENT

The Contractor shall inspect transport vehicles (dump trucks) for structural integrity and regulatory compliance, as appropriate. Structural integrity concerns may include holes or cracks in floors and/or walls, liners and/or tarps, previous contamination, and excessive oxidation (rusting). Other heavy equipment such as slurry mixers, excavators, and bulldozers arriving at the slurry wall work site for the first time will have already been decontaminated prior to their arrival.

Gross decontamination of equipment shall be performed whenever leaving the designated work area. Gross decontamination will focus on minimizing the spread of excavated soil as a result of equipment movement and transport. This decontamination process shall use dry methods (brooms, wipes, shovels, etc.) within the work zone in order to remove large, easy dislodged deposits of soil and/or other contaminated media prior to exiting the work zone.

Final decontamination of heavy equipment shall be implemented at the Asarco truck wash. The Contractor will receive instructions by the Owner on how and when to use the truck wash facility. Contractor's use of the truck wash facility can only be accomplished once gross decontamination of the equipment has been performed.

END OF SECTION

SITE PREPARATION

PART 1 GENERAL

1.1 SCOPE

The following items shall be completed prior to start of slurry wall excavation:

A) Submittal and approval of all pre-construction submittals.

B) Pre-construction meeting shall be conducted prior to the implementation or performance of any onsite work activities as outlined in the Design, Section 3.1 Pre-Construction Site Activities.

C) The pre-excavation trenching and plugging and abandoning in place underground utilities activities shall be completed as specified in Specification Section - Pre-Excavation Trenching and Underground Utilities.

D) The entire temporary cap currently covering the former Speiss-Dross area shall be completely removed as outlined in Section 3.1 of this Specification Section.

E) A working platform shall be constructed in low lying areas to provide an even working platform for trench installation as outlined in Section 3.2 of this Specification Section.

F) Stormwater controls shall be installed as appropriate and may include run-on/runoff berms, hay bales, and/or silt fence as outlined in Section 3.3 of this Specification Section.

G) Temporary construction fence (i.e., orange safety fence) shall be placed as necessary.

1.2 MOBILIZATION

Mobilization of personnel and construction equipment will occur upon written authorization from Asarco. Crews and equipment shall be mobilized and site setup performed in an organized and deliberate methodology to minimize or eliminate operational impacts to existing plant personnel, other Asarco subcontractors, and general traffic flow dynamics. The Contractor shall ensure that all activities performed under the direction of the Contractor do not negatively impact the environment or general condition of the site. All work shall be performed in strict compliance with the laws and regulations governing the work performed, worker safety, equipment and materials utilized security and the health and welfare of the public.

1.3 EQUIPMENT SET-UP AREAS

1.3.1 Suitable areas will be selected within the work area where heavy equipment (such as media mixers, excavators, dump trucks, and so on) may be staged during the site preparation and construction activities. Equipment set-up areas will be selected based upon accessibility to a targeted work area. The selected set-up area will not impede access to or traffic flow around specific targeted work areas. An additional Contractor "lay down" area will be provided in or about the main parking lot for the storage or offloading of "clean" materials and equipment only.

1.3.2 The Contractor shall maintain the area in a clean and organized manner at all times. Should the Contractor fail to keep the area clean and organized, Owner may require the Contractor to clean and organize the area within 48 hours without any liability to Owner for costs, lost production, schedule delay, etc. If the Contractor does not clean and organize the lay down area in the allotted time, Owner may require the Contractor to stop all work and remove all materials, equipment, etc from the lay down area, clean the lay down area per Owner, and continue the project with no lay down area maintaining all slurry wall and temporary capping operations within the former Speiss-Dross Plant area with no liability to Owner for any costs, lost production, schedule delay, etc.

1.4 GENERAL WORK PLAN

The Contractor shall submit to Asarco a General Work Plan describing how the Contractor will meet the design, specifications, and drawing in Section VI – Design Plan.

1.5 PRE-CONSTRUCTION MEETING

Prior to the construction activities, the Contractor will conduct a Pre-Construction Meeting. The Pre-Construction Meeting will be attended by Contractor, subcontractors (as appropriate), and Asarco. EPA and Montana Department of Environmental Quality will be invited to attend the Pre-Construction Meeting. Prior to or during this meeting all pre-construction submittals shall be submitted and/or approved by the appropriate authorities. Onsite work activities may proceed only after the proper approvals have been received for all pre-construction submittals including but not limited to the following items; General Work Plan, Site Specific Health and Safety Plan, permits, etc.

A subsequent site pre-construction meeting shall be conducted onsite prior to the performance of any work activities. This pre-construction meeting shall be attended by Contractor, Contractor's site employees, subcontractors (as appropriate), and subcontractor's employees as appropriate to discuss the objectives of the project including but not limited to the General Work Plan, Site Specific Health and Safety requirement (all personnel shall be required to read and sign Contractor's Site Specific Health and Safety Plan), coordination of contractor and subcontractor's activities, etc.

PART 2 MATERIALS

2.1 BORROW SOILS

An area south of the Owner facility near the proposed CAMU Phase 2 cell has been identified as the onsite borrow area by Owner. Soil shall be excavated from the CAMU area and transported via trucks to the slurry wall construction area. The onsite borrow soil shall be used for construction of a work platform, the slurry backfill mix, and berm construction, if needed. Some excess soils may be available from the CAMU Phase 2 cell construction for use as "borrow" soils but will be at the discretion of Owner whether these soils are available to the Contractor. Trucks

utilized to transport borrow soils shall be in good working condition with no holes in box, and tight sealing tailgate.

2.2 STORMWATER CONTROLS

Stormwater control products shall include run-on/runoff berms, hay bales, and/or silt fence typically as defined in Asarco's Stormwater Pollution Prevention Plan and as defined in the Standard Specifications for Road and Bridge Construction, edition of 1995, prepared by the Montana Department of Transportation and Montana Transportation Commission.

PART 3 EXECUTION

3.1 EXISTING TEMPORARY CAP

The temporary cap currently covering the area shall be completely removed. The existing RPE liner may be re-used for the re-installed temporary cap if Owner grants approval for re-use and the Contractor submits a certification that the existing RPE liner material meets the manufacturer's specifications for re-use. If the liner will be re-used then the liner shall be folded or rolled with the clean side out and placed in storage. The stored liner shall be placed on visqueen, covered with visqueen and the visqueen secured in place with sand bags. If the liner will not be re-used than the liner shall be hauled to the Ore Storage Building, or direct hauled to the CAMU for disposal as directed by the Owner.

The geotextile filter fabric shall be hauled to the Ore Storage Building, or direct hauled to the CAMU for disposal as directed by the Owner. Slag and fill materials beneath the existing temporary cap shall be loaded, transported, and stockpiled in an area determined by Owner for later re-use, if necessary to construct the new temporary cap subgrade. The storage area will be identified at the pre-bid conference.

3.2 WORKING PLATFORM

A working platform shall be constructed with borrow soils in low lying areas to provide a working platform for trench installation. No working platforms shall be more than 36-inches in height. Areas where elevation differences are greater than 36-inches will be "stepped down" or the Contractor must have written approval of Owner to increase the work platform height above 36-inches.

3.3 STORMWATER RUNOFF CONTROL MEASURES

Surface water run-off resulting from storm events that occur throughout the site preparation, construction of the slurry wall, and site restoration shall be properly managed in compliance with Asarco's Stormwater Pollution and Prevention Plan, all local, state, and federal laws, statutes, regulation, and permits applicable to the site and activities being performed on site.

END OF SECTION

SOIL-BENTONITE SLURRY WALL

PART 1 GENERAL

1.1 SCOPE

This section of the specifications includes requirements for the Soil-Bentonite Slurry Wall as indicated on the drawings, as hereinafter specified, or as required to properly complete the work.

1.2 GENERAL

The work covered by this section of the specifications consists of furnishing all submittals, permits, supervision, labor, equipment, supplies, and materials and of performing all operations in connection with constructing a fully functional and complete Soil-Bentonite slurry trench cut-off wall.

1.3 QUALIFICATION OF CONTRACTOR

The Contractor shall submit evidence to Owner that he is competent to construct a soil-bentonite slurry trench cut-off wall. This evidence will insure that the Contractor has sufficient competent personnel to carry out the operations specified, and such personnel will have previous experience in this type of construction (as approved by Owner prior to award of Contract). This evidence shall be submitted by the Contractor along with the bid proposal in the form of three detailed project resumes that the company has completed identifying the project name; project owner inclusive of name, working phone number, fax number, and address; scope of work performed inclusive of wall dimensions/depth; schedule conformance (on-time, late, etc); and any other relative information pertaining to the project. The Contractor shall provide personal resumes for the two "key" field personnel that will be direct the actual installation of the soil-bentonite slurry wall. These "key" people shall be the construction and Slurry Wall Specialists discussed in the following with their resumes containing at a minimum three detailed project resumes that the person has completed identifying the project name; project owner inclusive of name, working phone number, fax number, and address; scope of work performed inclusive of wall dimensions/depth; schedule conformance (on-time, late, etc); and any other relative information pertaining to the project.

As part of the Consent Decree agreement between EPA and Asarco, all work performed pursuant to this Part of the Decree shall be under the direction and supervision of a professional engineer, hydrogeologist, or environmental scientist with expertise in hazardous waste site investigation and remediation. This person shall have the technical expertise sufficient to adequately perform and/or direct all aspects of work for which he or she is responsible.

EPA reserves the right to disapproves Asarco's identified Contractor for reasons that shall be specified to Asarco in EPA's written notice of disapproval. If EPA disapproves of an identified Contractor, then Asarco must, within thirty (30) days of receipt of written notice of disapproval, notify EPA, in writing, of the name, title, and qualifications of any replacement.

The Contractor shall have a Construction and Slurry Wall Specialist(s) fully dedicated to, experience in and capable of supervising the construction of, slurry preparation, slurry backfill preparation and placement, and quality control monitoring and documentation for the soil-bentonite slurry wall. The Construction and Slurry Wall Specialist(s) shall be on site at all times when slurry, and/or slurry backfill are being mixed or installed in the slurry wall. The Slurry Wall Specialist shall be under the direction of the Contractor's Quality Control Manager.

1.4 CHARACTER OF OVERBURDEN MATERIALS

A generalized description of the typical overburden through which the slurry trench cut-off is to be excavated is indicated by boring logs included in the Section VI – Design Plan, Appendix D, Soil Borings. In general, the slurry wall shall extend through the overburden and "key" into the low permeability ash layer as indicated in the Drawings.

1.5 DUST CONTROL

The Contractor shall comply with applicable air pollution control requirements of federal, state or local regulations. The Contractor shall take appropriate actions to minimize atmospheric pollution. To minimize atmospheric pollution, the Owner shall have the authority to require that reasonable precautions be taken to prevent particulate matter from becoming airborne. Such reasonable precautions shall include, but not be limited to:

1. The use of water or chemicals for control of dusts in excavation activities. Chemicals for consideration to be utilized for dust control by the Contractor must be submitted to and approved by Asarco prior to mobilization or utilization of the chemicals onsite.
2. Covering, at all times when in motion, open-bodied trucks transporting materials likely to give rise to airborne dusts.

1.6 PROTECTION AND SAFETY

1.6.1 Open Excavations

Provide barricades, signs, and/or other safety equipment as required to protect the public, equipment, vehicles and workers from any open excavation.

1.6.2 Protection of Property

The Contractor shall protect adjacent property and avoid damage to such property. Adjacent property damaged due to the Contractor's operations shall be repaired or replaced by the Contractor at Contractor's expense. The repairs and/or replacement shall be equal to existing improvements and shall match existing finish and dimensions.

1.7 PERMITTING AND COORDINATION

1.7.1 Compliance with applicable requirements of the Montana Department of Environmental Air Quality Resources Management Bureau for activities that may result in air emissions.

1.7.2 Activities that affect or could potentially affect utilities (water, electrical, natural gas, sewage, etc.) shall be coordinated through Asarco.

1.7.3 Contractor shall obtain any other permits or certificates and pay all fees required for the performance of the work described or required whether stated, implied, or ancillary to successfully complete the project.

1.7.4 The Contractor is responsible for obtaining off-site and onsite utility locations as required by law.

1.8 SUBMITTALS

1.8.1 Daily Quality Control Report (DCQR)

Daily results from quality control testing, record of soundings, measurements taken during construction, and other quality control measures as documented in the Daily Quality Control Report (DCQR).

1.8.2 Certificates

Certificate of Compliance for bentonite with the specification shall be obtained from the material manufacturer.

PART 2 PRODUCTS

2.1 PROPERTIES OF SLURRY

The bentonite slurry shall be a fluid allowing proper excavation of the trench and allowing backfilling with impervious material to form a permanent cut-off wall.

2.1.1 Materials

(A) Bentonite - The bentonite powder used in the slurry shall be natural high-swelling sodium bentonite consisting of a clay mineral montmorillonite base product, which swells several times its own volume when wetted, and shall meet the requirements of API Specification 13A for Drilling Fluid Materials.

(B) Water - The water shall be clean, fresh, and free from excessive oil, acid, alkali, organic matter, or other deleterious substances. The city of East Helena municipal water has been identified as the water source. It is the responsibility of the Contractor that the slurry resulting from the water shall always meet the standards in this specification.

(C) Additives - Admixtures such as softening agents may be used to alter the characteristics of the water to permit efficient bentonite consumption. Additives/admixtures shall be submitted to and approved by Asarco prior to mobilizing or utilizing the additive/admixture onsite.

2.1.2 Slurry Mixture

The bentonite slurry shall consist of a stable colloidal suspension of sodium bentonite in water and shall be controlled in accordance with API RP 13B-1 "Recommended Standard Procedure for Field Testing Water-Based Drilling Fluids" (most current edition), and the following requirements:

(A) At the time of introduction of the slurry into the trench, the initial slurry shall be a mixture of not less than 5 % by weight of bentonite to water. Additional bentonite may be required depending on the hardness and temperature of the water. The slurry shall have a minimum apparent viscosity of 15 centipoises or 40 seconds reading through a Marsh Funnel Viscosimeter, a maximum filtrate loss of 25 cubic centimeters in 30 minutes at 100 psi, and a pH of 6.5 to 10.0.

(B) The slurry mixture in the trench shall have a density not less than 64 pcf (1.03 gm/cc), not greater than 85 pcf (1.36 gm/cc), or as approved by the Contractor's Slurry Wall Specialist.

(C) The slurry mixed with backfill material shall be either slurry taken from the trench or slurry meeting the requirements of slurry introduced into the trench.

(D) If the density of the slurry in the trench exceeds the specified limits, or becomes unworkable, the heavy slurry shall be removed from the trench by airlift pump, excavator, or other methods approved by the Contractor's Slurry Wall Specialist or the excess solids shall be removed from the slurry by screening or centrifugal type slurry desander.

(E) Admixtures of the types used in the control of oil field drilling muds may be used to alter the characteristics of the slurry in the trench only as approved by the Contractor's Slurry Wall Specialist and Asarco as stated above. Peptizing or bulking agents shall not be mixed with the slurry.

2.1.3 Slurry Mixing Plant

(A) All slurry for use in the trench shall be prepared using a suitable mixer. No slurry is to be made in the trench. Mixing of water and bentonite shall continue until bentonite particles are fully hydrated and the resulting slurry appears homogeneous.

(B) The slurry plant shall include the necessary equipment such as a mixer capable of producing a colloidal suspension of bentonite in water, sumps, pumps, valves, hoses, supply lines, small tools, and all other equipment as may be required to adequately supply slurry to the trench.

(C) Storage tanks may be provided to store initially mixed slurry to allow hydration and to serve as a reserve in cases where substantial loss from the trench through underlying pervious zones or other reasons may occur. The slurry shall be agitated or recirculated in any storage

tanks as required to maintain a homogeneous mix. Slurry ponds are not acceptable due to limited space requirements of the site.

2.2 SELECT GRANULAR SOILS

Select Granular Soils or Satisfactory soil shall be soil materials free of debris, waste, frozen materials, clay, rock, gravel, or other deleterious matter larger than 3 inches in any dimension. The Contractors Slurry Wall Specialist shall verify that soils utilized in the slurry wall are in compliance with the backfill mix design requirements and are satisfactory in their composition and nature to maintain the integrity of the backfill mix design.

PART 3 EXECUTION

3.1 EXCAVATION OF SLURRY TRENCH

3.1.1 General Requirements

A slurry trench cut-off wall shall be constructed as indicated on the Drawings. The trench shall have essentially vertical (plumb) walls, a minimum width of 3 feet and shall extend through the aquatard (low permeability ash unit) to minimum specified penetration of 2 feet. Final location of the former Speiss-Dross slurry wall alignment will be determined in the field based on minor relocations required to avoid foreseen obstacles. Any deviation of more than 2 feet to the slurry wall plan location must be approved by the Owner in writing prior to proceeding with any alterations to the location of the slurry wall. Contractor must anticipate these minor adjustments in the alignment and depth of the slurry wall in their bid as no allowances or change orders will be permitted for adjustments to the slurry wall alignment or final depths of excavation.

Stockpiles and processing (screening) of all excavated soils, spoils, debris, etc. shall be performed within the limits of the slurry wall alignment so potentially contaminated materials or liquids are kept within the alignment of the slurry wall.

3.1.2 Prosecution of Work

(A) Slurry shall be introduced into the trench immediately after trenching has begun and shall be maintained in the trench during excavation and until it is completely backfilled.

(B) The Contractor shall maintain the stability of the excavated trench at all times for its full depth. The level of the bentonite slurry shall not be permitted to drop more than 3 feet below the top of the slurry trench except as approved by the Owner.

(C) The Contractor shall have personnel, equipment, and materials ready to raise the slurry level at any time. To this end, the Contractor shall have personnel on call to raise the slurry level at any time during the week, weekends and/or holidays included.

(D) Unless otherwise directed, the bottom of the slurry trench will be keyed the minimum specified penetration (see 3.1.1) into the underlying aquatard (low permeability ash unit) beneath the site as indicated by soil borings, except that if the excavator is unable to achieve the minimum specified penetration into weathered rock without the assistance of ripping teeth,

blocks or percussion chisels, the minimum penetration requirements will be modified and the trench will extend to the depth where refusal of the excavating equipment is encountered. The final depth and penetration of the trench shall be measured and checked by the Contractor.

(E) Upon completion of excavation, any loose material or cuttings shall be removed from the bottom of the trench with the excavator.

(F) The toe of the slope of the trench excavation shall precede the toe of the backfill slope so that the toe of the backfill shall be more than 50 feet away from the toe of the excavation or as required to permit proper cleaning of the trench bottom and to permit inspection and measurement.

3.2 BACKFILLING OF SLURRY TRENCH

3.2.1 Materials

The material for trench backfilling shall be composed of slurry and selected granular soils obtained from the trench excavation and/or an approved borrow area. Dry bentonite, in addition to that added via the slurry shall be added to the backfill at a rate of 2 pounds per cubic foot of backfill mix or 1% per dry unit weight of backfill. The soil shall be friable and free from roots, organic matter, or other deleterious materials. The backfill shall be thoroughly mixed and reasonably well graded between the following gradation limits:

Screen Size (U.S. Standard)	Percent Passing by Dry Weight
3 inch	<100%
0.075 mm	>15%

3.2.2 Mixing

Stockpiled material from excavation and/or material from borrow shall be mixed and blended by windrowing, disk harrowing, bulldozing, blading, hoeing or by other approved methods. Mixing and blending shall be performed in such a manner as to produce the required gradation of backfill. The backfill material shall be thoroughly mixed into a homogeneous mass, free from large lumps or pockets of fines, sand, or gravel. Occasional lumps of up to 4 inches in their largest dimensions will be permitted. Just prior to placing, the backfill material shall have a slump of 3 to 6 inches. To this end, the materials may be sluiced with slurry during blending operations. Sluicing with water will not be permitted except as approved by the Contractor's Slurry Wall Specialist.

3.2.3 Placing

The backfill shall be placed continuously from the beginning of the trench, in the direction of the excavation, to the end of the trench. Free dropping of backfill material through the slurry will not be permitted. Initial backfill shall be placed by lowering it to the bottom of the trench with an excavator bucket until the surface of the backfill rises above the surface of the slurry trench at the start of the trench. Additional backfill may then be placed in such a manner that the new material

slides down the forward face of the previously placed backfill. The backfill shall not be dropped or deposited in any manner that will cause segregation. An acceptable substitute for the initial placing of backfill by the use of an excavator bucket shall be to begin excavation of a sloping "starter or lead-in" trench at a point outside of the limits of work which will provide a sufficient distance for the backfill face to form before the toe of the backfill reaches the point where the cut-off is required.

3.3 CLEANUP AND WASTE MANAGEMENT

After completion of the backfill all remaining excavated material (excess soil, spoils), work platform materials, excess borrow material, and slurry not previously stockpiled shall be placed within the slurry wall alignment. The excess slurry, excess soil, and the spoils shall be handled in the following steps:

(A) The soil used for the working platform, all spoil stockpiles shall be placed inside the slurry wall footprint.

(B) The excess slurry mixture shall be placed inside the slurry wall footprint in the middle of the former Speiss-Dross Plant area and mixed with available "dryer" spoils and any excess soil.

(C) The excess slurry-spoils-soils mix shall require solidification prior to construction of the temporary cap. "Solidification" shall use a sufficient quantify of cement to solidify the excess slurry-spoils-soils mix without creating a huge mass of cement/concrete. The solidified material shall be a consistency sufficient for grading and providing a suitable subgrade for placement of the temporary liner inclusive of sufficient subgrade strength to bear the weight of a human without impacting subgrade integrity or suitability.

(D) The solidified slurry-spoils-soils shall be graded within the slurry wall footprint to create positive drainage away from the slurry wall and in the directions as generally shown on the drawings.

3.4 QUALITY CONTROL

The Contractor shall maintain his own quality control for the cut-off wall construction under the direction of the Contractor's Slurry Wall Specialist. Table 1 outlines the Soil - Bentonite Slurry Trench Quality Control Testing requirements and frequency.

3.4.1 Trench Continuity and Key

The Contractor's Construction Specialist shall be responsible for demonstrating to the satisfaction of the Contractor's Slurry Wall Specialist that the trench is continuous and excavated to the minimum specified depth into the underlying aquaclude as shown on Drawings 2 through 5. Trench continuity shall be assured by the action of the trench excavation equipment, the digging tools must be able to be passed vertically from top to bottom of the trench as well as moved horizontally along the axis of the trench without encountering unexcavated material. Penetration of the bottom of the trench into the aquaclude shall be demonstrated by observation

of the cuttings removed from the trench and by direct measurement of trench depth to the satisfaction of the Contractor's Slurry Wall Specialist.

3.4.2 Slurry and Backfill Mix Materials

(A) Water - Water for making slurry shall be tested for pH and total hardness as required to determine the amount of softening agent necessary to assure optimum yield of the bentonite. Tests shall be repeated each time that the water source is changed.

(B) SB Backfill Mix – SB backfill material shall be tested prior to placement in the trench by conducting tests to determine slump and gradation (see Table 1 of this Specification Section for test frequency). The Contractor's Slurry Wall Specialist shall determine the amount of bentonite added.

3.4.3 Slurry Introduced in the Trench

A complete series of tests shall be conducted on slurry from the pond containing slurry ready for introduction in the trench at least once per day. The tests shall include:

(A) pH of the slurry,

(B) Unit weight of the slurry,

(C) Filtrate loss of the slurry (once per truckload or lot),

(D) Viscosity of the slurry.

3.4.4 Slurry in the Trench

Slurry in the trench shall be tested at least once per day. Samples shall be obtained from near the bottom of the trench near the point of trenching and tested for unit weight.

3.4.5 Documentation

Results of all tests performed in accordance with the Specification shall be recorded on Daily Quality Control Report forms acceptable to Owner. Copies of all forms shall be submitted daily to Owner for review and approval.

3.5 INSPECTION AND DECONTAMINATION OF HEAVY EQUIPMENT

The Contractor shall inspect transport vehicles (dump trucks) for structural integrity and regulatory compliance, as appropriate. Structural integrity concerns may include holes or cracks in floors and/or walls, liners and/or tarps, previous contamination, and excessive oxidation (rusting). Other heavy equipment such as slurry mixers, excavators, and bulldozers arriving at the slurry wall work site for the first time will have already been decontaminated prior to their arrival.

Gross decontamination of equipment shall be performed whenever leaving the designated work area. Gross decontamination will focus on minimizing the spread of excavated soil as a result of equipment movement and transport. This decontamination process shall use dry methods (brooms, wipes, shovels, etc.) within the work zone in order to remove large, easy dislodged deposits of soil and/or other contaminated media prior to exiting the work zone.

Final decontamination of heavy equipment shall be implemented at the Asarco truck wash. The Contractor will receive instructions by the Owner on how and when to use the truck wash facility. Contractor's use of the truck wash facility can only be accomplished once gross decontamination of the equipment has been performed.

3.6 DEMOBILIZATION AND SITE RESTORATION

Upon completion of slurry wall and temporary cap construction activities, heavy equipment shall be decontaminated and demobilized from the project site. All materials and supplies shall be removed from the site. Installation equipment will be brushed off and washed, as necessary, to remove all soil or debris from the equipment before removal from the site. Temporary facilities (e.g., field office, port-a-johns, and so on) and signs erected during this work shall be removed. All stormwater controls and the construction fence shall be removed.

All debris and trash shall also be placed in Asarco-provided dumpsters. Pre-final and final inspections shall be conducted to ensure that the site is returned to contractual conditions. The Owner will sign-off on the final inspection to concur that the site was returned to contractual conditions.

3.7 FINAL REPORT

Following completion of the slurry wall and temporary cap construction, a Final Report shall be generated and submitted to the Owner. At a minimum, this report shall document the following:

- Documentation of the slurry wall and temporary cap construction, including topographic survey of area and survey of the extended monitoring wells;
- A summary of the evaluation of the alternatives that led to the selection of the slurry wall remedy will be provided by Asarco for inclusion in the Final Report;
- Copies of the Daily Logs,
- Copies of quality control documentation including laboratory permeability testing reports, and
- A statement that the work was completely substantially in accordance with the Contract Documents.

Table 1: Soil - Bentonite Slurry Trench Quality Control Testing Plan

Property	Requirement	Min. Test Frequency	Test Method	Comment
Bentonite Powder				
a. Certification	API 13A	1 per truck or lot	--	Manufactures Certification
Water for Slurry Mixing				
a. pH	6 to 9	1 per source	API RP 13B-1	May be modified for
b. Hardness	< 500 ppm	1 per source	API RP 13B-1	potable source or if treated
Solids				
Initial Bentonite Slurry				
a. Viscosity	> 40 seconds	2 per shift	API RP 13B-1	
b. Density	> 64 pcf	2 per shift	ASTM D-4380	
c. Filtrate Loss	< 25 cc	1 per truckload	API RP 13B-1	
d. Bentonite content	> 5%	1 per project	Weight-Volume	Demonstrate by proportion
e. pH of Slurry	6.5 to 10	1 per shift	API RP 13B-1	
In-Trench Bentonite Slurry				
a. Unit Weight	64 to 85 pcf	2 per shift	ASTM D-4380	Also > 15 pcf less than SB
b. Viscosity	> 40 seconds	2 per shift	API RP 13B-1	
SB Backfill Material				
a. Slump Cone	3 to 6 inches	1 per shift	ASTM C-143	
b. Gradation	Minimum 15% Fines	1 per shift	ASTM D-1140	Laboratory or Field Test
c. Density	15 pcf > In-trench slurry	1 per shift	ASTM C-138 or API RP 13B-1 D-4380 mod	
d. Bentonite content	> 1 %	1 per shift	Weight-Volume	
e. Permeability	< $1x10^{-7}$ cm/sec	1 per 500 cy	ASTM D-5084	Laboratory test

END OF SECTION

SUBMITTALS

PART 1 GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

This Section specifies the general method and requirements of submissions applicable to the Contractor's work-related submittals. Detailed submittal requirements are also specified in individual Specification Sections.

All submittals shall be clearly identified by reference to specification Sections, Paragraph, Drawings Number, or Detail as applicable. Submittals shall be clear and legible and of sufficient size for sufficient presentation of data.

1.2 GENERAL PROCEDURES FOR SUBMITTALS

All submittals prepared and/or submitted by the Contractor for Owner's review, shall be sent directly to Owner for the initial checking and coordination.

Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual Sections, of the specifications, so that the installation will not be delayed by processing time including disapproval and resubmittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery, and similar sequenced activities. No extension of time will be authorized because of the Contactor's failure to transmit submittals sufficiently in advance of work. Submittals must be submitted a minimum of ten (10) working days in advance of work but may require a greater "lead" time dependant on the complexity and scope of the submittal.

1.3 CONTRACTOR'S RESPONSIBILITIES

The Contractor shall review all submittals, including those by subcontractors, prior to submission to determine and verify the following:

- Field measurement
- Field construction criteria
- Conformance with the Specifications and Drawings

Submittals 11-inch by 17-inch and smaller shall be bound together in an orderly fashion and bear the Contractor's name, indication that the Contractor reviewed and verified the submittal, submittal date, and include a reference to the applicable Specification Section, Drawing, or requirement.

Notify Owner in writing, at the time of submittal, of any deviations in the submittals from the requirement of the Contract Documents.

The review and approval of any submittals by Owner shall not relieve the Contractor from the Contractor's responsibility with regard to the fulfillment of the terms on the Contract. All risks of errors and omission are assumed by the Contactor and Owner will have no responsibility therefore.

No portion of the Work requiring a submittal shall be started nor shall any materials be fabricated or installed prior to the approval or qualified approval of such item. Fabrication performed, materials purchased, or onsite construction accomplished, which does not conform to approved submittals, shall be at the Contractor's risk. Owner may require the Contractor to remove from the Site any material that has not been approved for use on this Project. Owner will not be liable for any expense or delay due to correction or remedies required to accomplish conformity.

Project work, materials, fabrication, and installation shall conform with approved submittals.

1.4 SUBMISSION REQUIREMENTS

Make submittals promptly as to cause no delay in the work or the work of any other contractor.

Number of submittals required (unless other noted; in case of a conflict the largest number of required submittals shall govern):

- Contractor's Site Specific Health and Safety Plan: One copy (either electronic or paper copy)
- General Work Plan: Four copies
- Bentonite Powder Certification: Two copies
- Admixture/Additives for the slurry, if needed: Two copies
- Dust suppression agents other than water, if needed: Two copies
- Product data: Two copies
- Warranty Guarantee for 25 mil OR RPE: Two copies
- Temporary Cap Panel Layout Plan, if cap is larger than 200,000 SF: Two copies
- Mix design for Flowable Fill: Two copies
- Daily Quality Control reports: One copy
- Final Report: Eight copies

Submittals shall also contain:

- The date of submission and the dates of any previous submission;
- Contractor's name;
- Indication that the Contractor reviewed and verified the submittal; and
- Reference to the applicable Specification Section, Drawing, or requirement.
- Identification of deviation from Contract Documents.
- Identification of revision of submittals.

1.5 OWNER'S REVIEW OF SUBMITTALS

The review of submittals will be for general conformance with the design concept and Contract Documents. They shall not be construed:

- As permitting any departure from the Contract requirements.
- As relieving the Contractor of responsibility for any errors, including details, dimensions, and materials.
- As approving departures from details furnished by Owner, except as otherwise provided herein.

The Contractor remains responsible for details and accuracy, for coordinating the work with all other associated work and trades, for techniques of construction, and for performing work in a safe manner.

1.6 CONTRACTOR'S PLANS, DESIGN, AND TESTING SUBMITTALS

Requirements for submittals to be prepared and submitted by (or through) the Contractor are defined in individual specification Sections.

END OF SECTION

APPENDIX B

DRAWINGS

List of Drawings

Drawing 1	**Former Speiss-Dross Plant Area Slurry Wall Location**
Drawing 2	**Slurry Wall Profile Side A, Former Speiss-Dross Plant Area**
Drawing 3	**Slurry Wall Profile Side B, Former Speiss-Dross Plant Area**
Drawing 4	**Slurry Wall Profile Side C, Former Speiss-Dross Plant Area**
Drawing 5	**Slurry Wall Profile Side D, Former Speiss-Dross Plant Area**
Drawing 6	**Temporary Cap Layout with Slurry Wall Locations and Cross Section Line A-A'**
Drawing 7	**Miscellaneous Details, Former Speiss-Dross Plant Area**

NOTES

1. THE BASIS OF BEARING IS THE ASARCO COORDINATE SYSTEM.

2. ELEVATION DATUM IS THE ASARCO VERTICAL DATUM.

3. DEMOLITION OF BUILDINGS AND MOST OF THE RAILROAD TRACKS WITHIN AND BEYOND THE SLURRY WALL LOCATION HAS BEEN DONE OR WILL BE DONE BY OTHERS PRIOR TO THE START OF THE SLURRY WALL CONSTRUCTION ACTIVITIES. THE CONTRACTOR SHALL REMOVE RAILROAD TRACKS AT THE TWO NOTED LOCATIONS.

4. ALL MONITORING WELLS AND TEST WELL SHALL BE PROTECTED AT ALL TIMES AND SHALL NOT BE DAMAGED DURING CONSTRUCTION ACTIVITIES.

5. THE EXISTING TEMP. CAP WITHIN THE FOOTPRINT OF THE PROPOSED SLURRY LOCATION SHALL BE COMPLETELY REMOVED PRIOR TO THE START OF THE SLURRY WALL CONSTRUCTION. FILL MATERERIAL UNDER THE EXISTING CAP SHALL BE REMOVED AND STOCKPILED AS DIRECTED BY ASARCO.

6. THE EXISTING ROADWAY SHALL BE KEPT CLEAR FOR CONTINUOUS ACCESS TO NEAR BY BUILDINGS.

LEGEND

TW-1	TEST WELL
SD-2	BOREHOLE
DH-27	MONITORING WELL
	RAILROAD
	PROPOSED SLURRY WALL LOCATION
	2006 EXISTING TEMPORARY CAP

SCALE: 1" = 60'

REVISION	DESCRIPTION	CHECKED	APPROVED	DATE
0	ISSUED TO ASARCO	DRC	RM	04/25/07

ASARCO, LLC

ASARCO SMELTER FACILTY

DRAWING NUMBER 1

FORMER
SPEISS-DROSS PLANT AREA
SLURRY WALL LOCATION

Shaw Environmental, Inc.

	BY	DATE		BY	DATE	PROJECT NO.	REV.	FILE NAME
DESIGNED	DRC	03/27/07	CHECKED	DRC	04/09/07	125406.1000	0	125406A040
DRAWN	MEC	03/27/07	APPROVED	RM	04/09/07			

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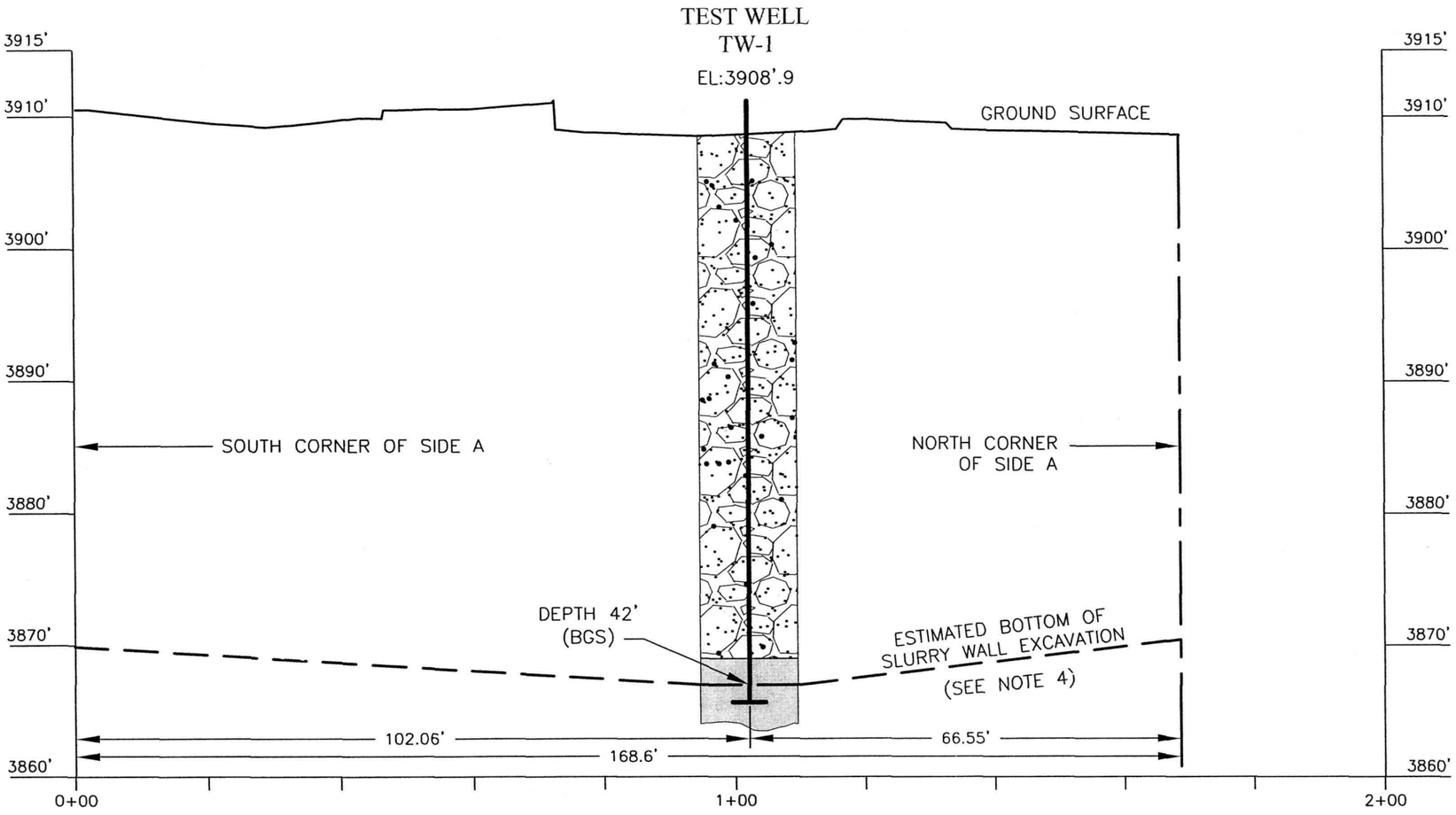


NOTES

1. SHOWN PROFILE IS BASED ON THE PROPOSED SLURRY WALL ALIGNMENT. FINAL SLURRY WALL ALIGNMENT (I.E., LOCATION AND LENGTH) WILL BE DETERMINED IN THE FIELD BY THE FOUR (4) CORNERS, WHICH WILL BE ESTABLISHED BY ASARCO.

2. TEST WELL TW-1 IS NOT LOCATED ON SLURRY WALL ALIGNMENT. (PROJECTED TO PROFILE)

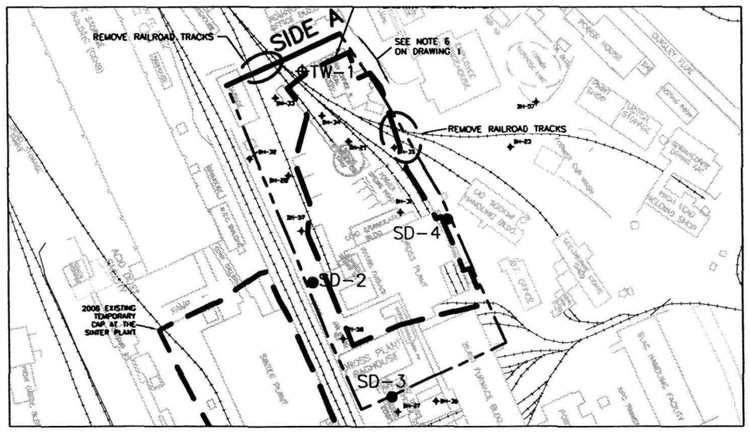
3. ELEVATION DATUM IS THE ASARCO VERTICAL DATUM.

4. THE TRENCH SHALL BE EXCAVATED A MINIMUM OF TWO (2) FEET INTO THE EXISTING LOW PERMEABILITY VOLCANIC ASH-TUFF LAYER. ACTUAL FINAL DEPTHS MAY VARY FROM THESE SHOWN.

LEGEND

SANDY SILT, SAND AND GRAVEL (SEE BORING LOGS FOR MORE DETAILS)

VOLCANIC ASH-TUFF



LOCATION MAP
SCALE: 1" = 200'

SCALE: 1" = 10' VERTICAL EXAGGERATION 2X

10
0
20

SCALE: 1" = 20' HORIZONTAL

REVISION	DESCRIPTION	CHECKED	APPROVED	DATE
0	ISSUED TO ASARCO, LLC	ERC	RM	04/25/07

ASARCO, LLC

ASARCO SMELTER FACILITY

DRAWING NUMBER 2

SLURRY WALL PROFILE SIDE A
FORMER SPEISS-DROSS PLANT AREA

Shaw™ Environmental, Inc.

	BY	DATE		BY	DATE	PROJECT NO.	REV.	FILE NAME
DSND	MEC	03/19/07	CHKD	ERC	04/09/07	125406.1000	0	125406A040
DRAWN	MEC	03/19/07	APPR	RM	04/09/07			

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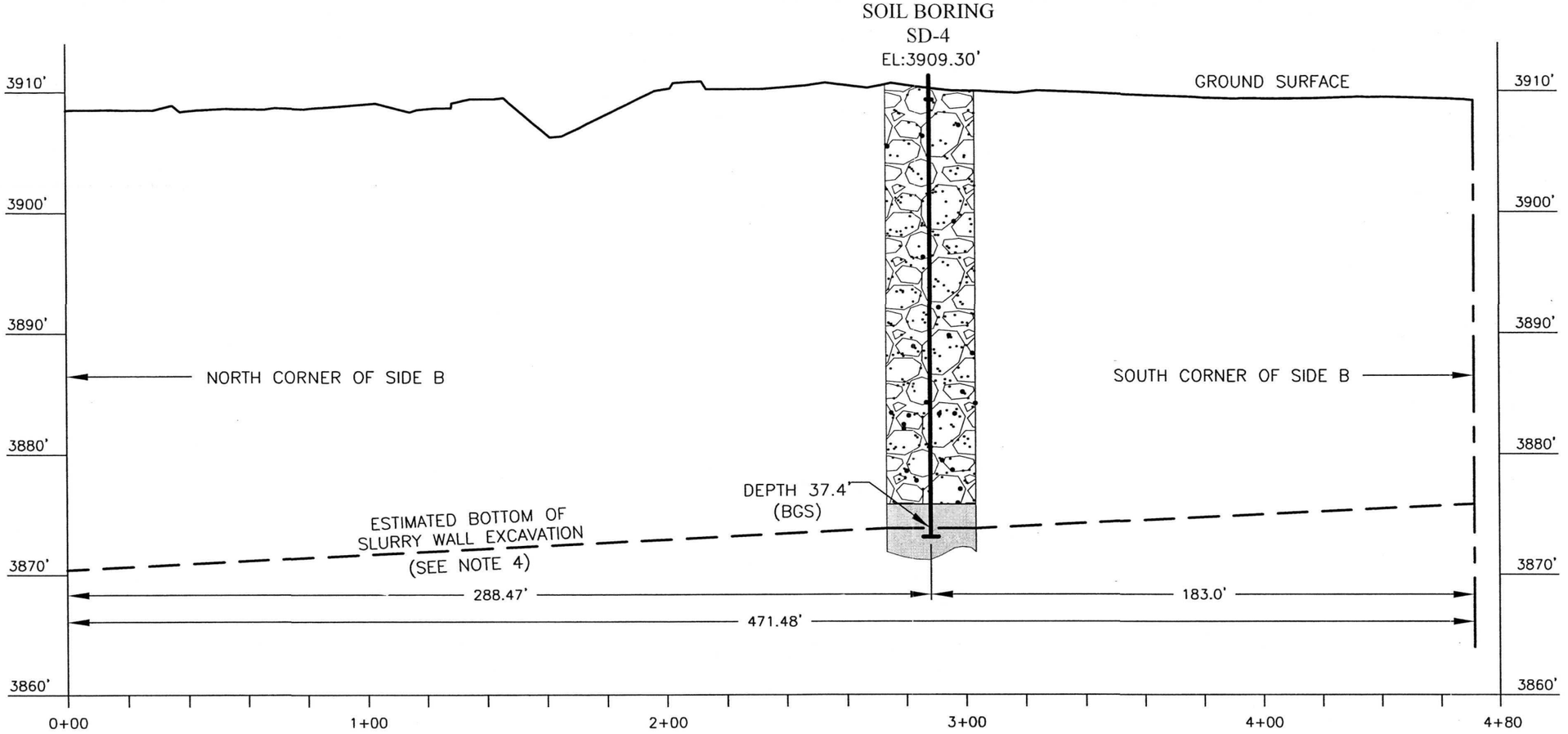


NOTES

1. SHOWN PROFILE IS BASED ON THE PROPOSED SLURRY WALL ALIGNMENT. FINAL SLURRY WALL ALIGNMENT (I.E., LOCATION AND LENGTH) WILL BE DETERMINED IN THE FIELD BY THE FOUR (4) CORNERS, WHICH WILL BE ESTABLISHED BY ASARCO.

~~2. SOIL BORING SD-4 IS NOT LOCATED ON SLURRY WALL ALIGNMENT (PROJECTED TO PROFILE).~~

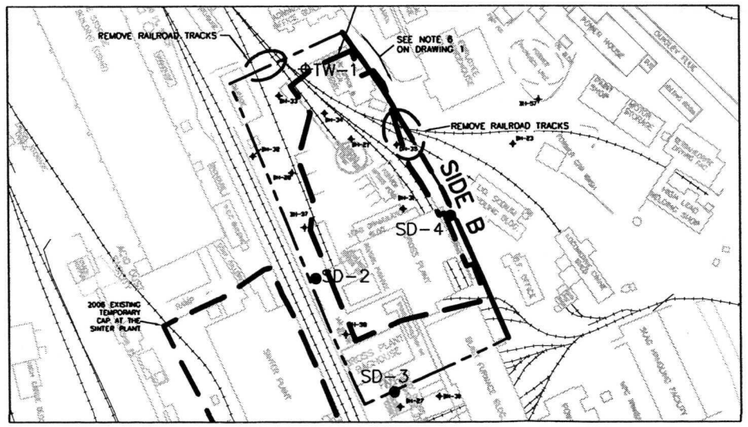
3. ELEVATION DATUM IS THE ASARCO VERTICAL DATUM.

4. THE TRENCH SHALL BE EXCAVATED A MINIMUM OF TWO (2) FEET INTO THE EXISTING LOW PERMEABILITY VOLCANIC ASH-TUFF LAYER. ACTUAL FINAL DEPTHS MAY VARY FROM THOSE SHOWN.

LEGEND

SANDY SILT, SAND AND GRAVEL (SEE BORING LOGS FOR MORE DETAIL)

VOLCANIC ASH-TUFF



LOCATION MAP
SCALE: 1" = 100'

SCALE: 1" = 10'
VERTICAL EXAGGERATION 4X

10
0
40

SCALE: 1" = 40'
HORIZONTAL

REVISION	DESCRIPTION	CHECKED	APPROVED	DATE
0	ISSUED TO ASARCO, LLC	ERC	RM	04/25/07

ASARCO, LLC

ASARCO SMELTER FACILITY

DRAWING NUMBER 3

SLURRY WALL PROFILE SIDE B
FORMER SPEISS-DROSS PLANT AREA

Shaw Environmental, Inc.

	BY	DATE		BY	DATE	PROJECT NO.	REV.	FILE NAME
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DRAWN	MEC	03/19/07	APPR	RM	04/09/07			

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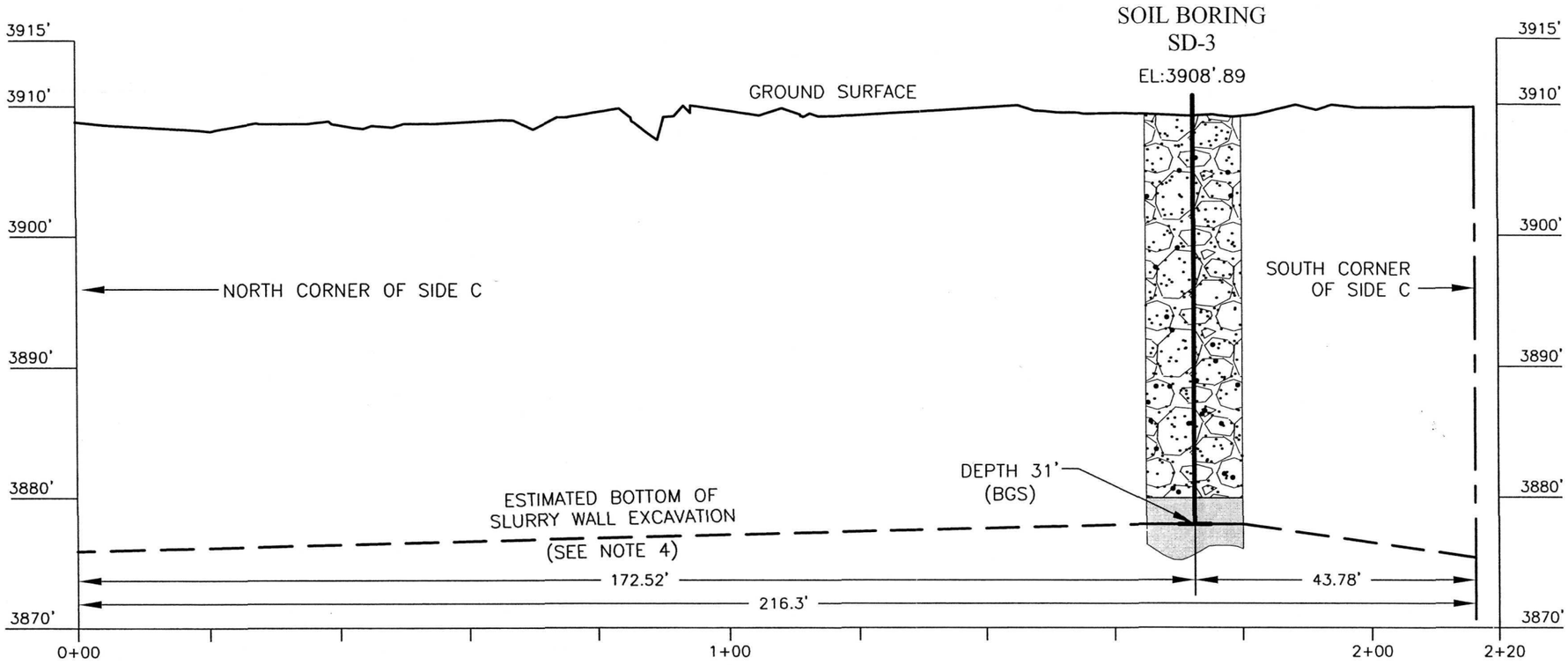


NOTES

1. SHOWN PROFILE IS BASED ON THE PROPOSED SLURRY WALL ALIGNMENT. FINAL SLURRY WALL ALIGNMENT (I.E., LOCATION AND LENGTH) WILL BE DETERMINED IN THE FIELD BY THE FOUR (4) CORNERS, WHICH WILL BE ESTABLISHED BY ASARCO.

~~2. SOIL BORING SD-3 IS NOT LOCATED ON SLURRY WALL ALIGNMENT (PROJECTED TO PROFILE).~~

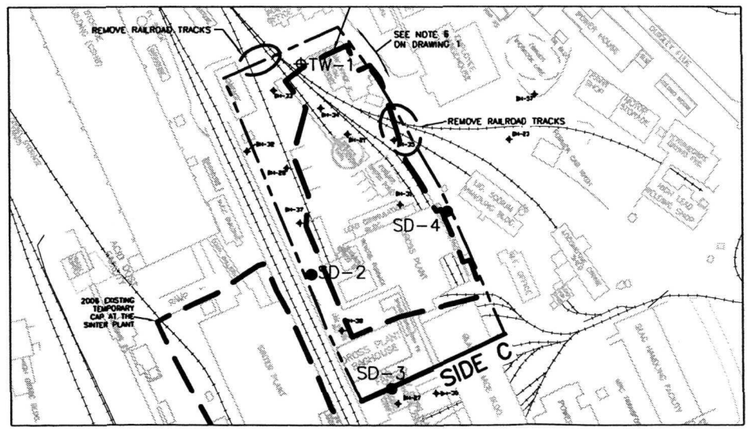
3. ELEVATION DATUM IS THE ASARCO VERTICAL DATUM.

4. THE TRENCH SHALL BE EXCAVATED A MINIMUM OF TWO (2) FEET INTO THE EXISTING LOW PERMEABILITY VOLCANIC ASH-TUFF LAYER. ACTUAL FINAL DEPTHS MAY VARY FROM THOSE SHOWN.

LEGEND

SANDY SILT, SAND AND GRAVEL (SEE BORING LOGS FOR MORE DETAILS)

VOLCANIC ASH-TUFF



LOCATION MAP
SCALE: 1" = 200'

SCALE: 1" = 10'
VERTICAL EXAGGERATION 2X

10
0
20'

SCALE: 1" = 20'
HORIZONTAL

REVISION	DESCRIPTION	CHECKED	APPROVED	DATE
0	ISSUED TO ASARCO, LLC	ERC	RM	04/25/07

ASARCO, LLC

ASARCO SMELTER FACILITY

DRAWING NUMBER 4

SLURRY WALL PROFILE SIDE C
FORMER SPEISS-DROSS PLANT AREA

Shaw Environmental, Inc.

	BY	DATE		BY	DATE	PROJECT NO.	REV.	FILE NAME
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DRAWN	MEC	03/19/07	APPR	RM	04/09/07			

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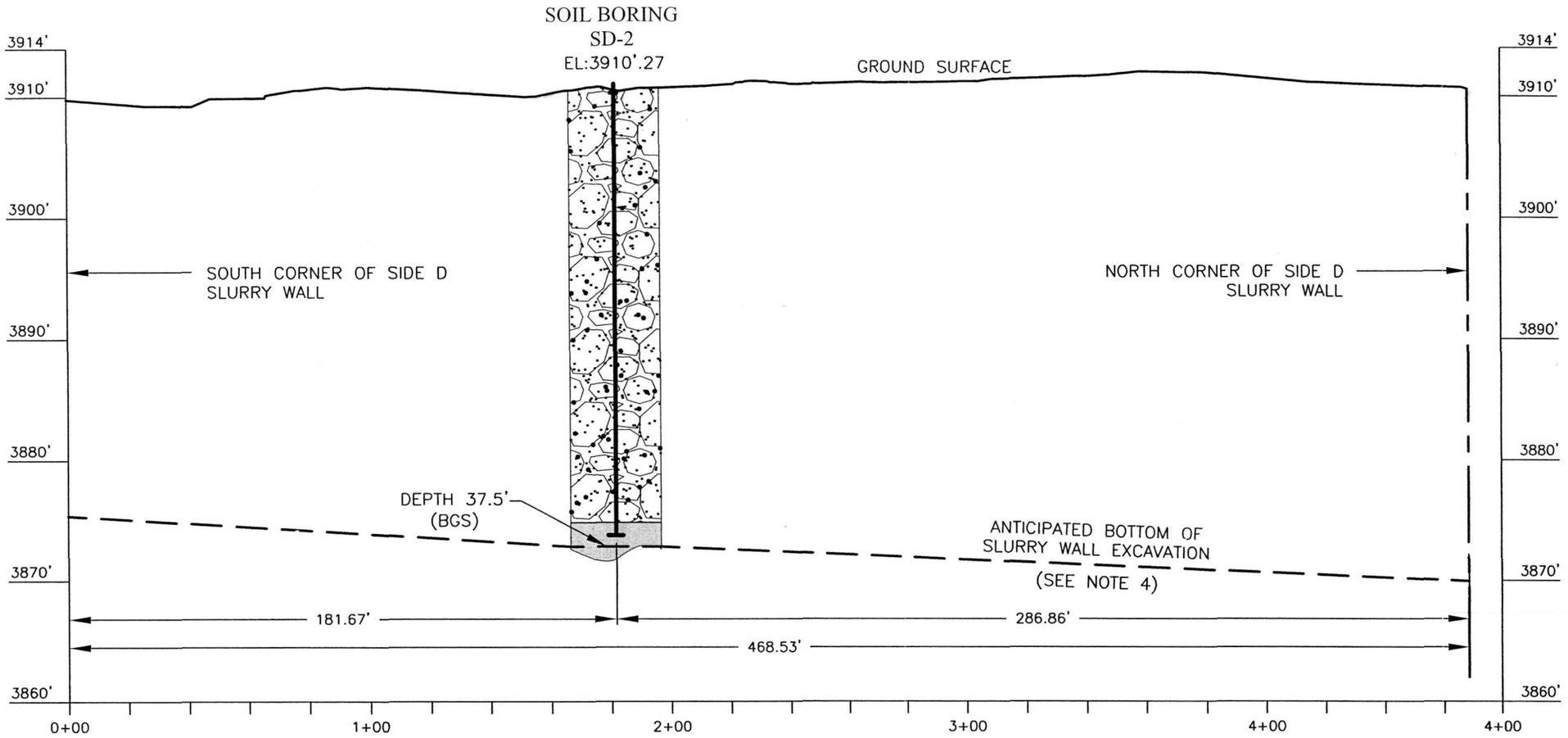


NOTES

1. SHOWN PROFILE IS BASED ON THE PROPOSED SLURRY WALL ALIGNMENT. FINAL SLURRY WALL ALIGNMENT (I.E., LOCATION AND LENGTH) WILL BE DETERMINED IN THE FIELD BY THE FOUR (4) CORNERS, WHICH WILL BE ESTABLISHED BY ASARCO.

~~2. SOIL BORING SD-2 IS NOT LOCATED ON SLURRY WALL ALIGNMENT (PROJECTED TO PROFILE).~~

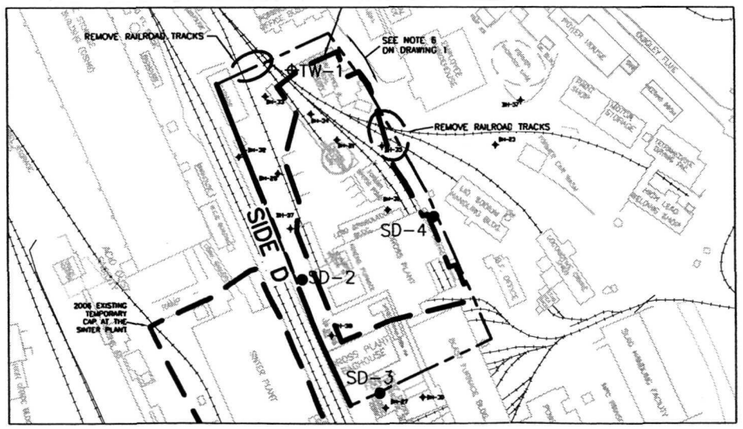
3. ELEVATION DATUM IS THE ASARCO VERTICAL DATUM.

4. THE TRENCH SHALL BE EXCAVATED A MINIMUM OF TWO (2) FEET INTO THE EXISTING LOW PERMEABILITY VOLCANIC ASH-TUFF LAYER. ACTUAL FINAL DEPTHS MAY VARY FROM THOSE SHOWN.

LEGEND

SANDY SILT, SAND AND GRAVEL (SEE BORING LOGS FOR MORE DETAILS)

VOLCANIC ASH-TUFF



LOCATION MAP
SCALE: 1" = 100'

SCALE: 1" = 10'
VERTICAL EXAGGERATION 4X

10
0
40

SCALE: 1" = 40'
HORIZONTAL

REVISION	DESCRIPTION	CHECKED	APPROVED	DATE
0	ISSUED TO ASARCO, LLC	ERC	RM	04/25/07

ASARCO, LLC

ASARCO SMELTER FACILITY

DRAWING NUMBER 5

SLURRY WALL PROFILE SIDE D
FORMER SPEISS-DROSS PLANT AREA

Shaw Environmental, Inc.

	BY	DATE		BY	DATE	PROJECT NO.	REV.	FILE NAME
DSND	MEC	03/19/07	CHKD	ERC	04/09/07	125406.1000	0	125406A040
DRAWN	MEC	03/19/07	APPR	RM	04/09/07			

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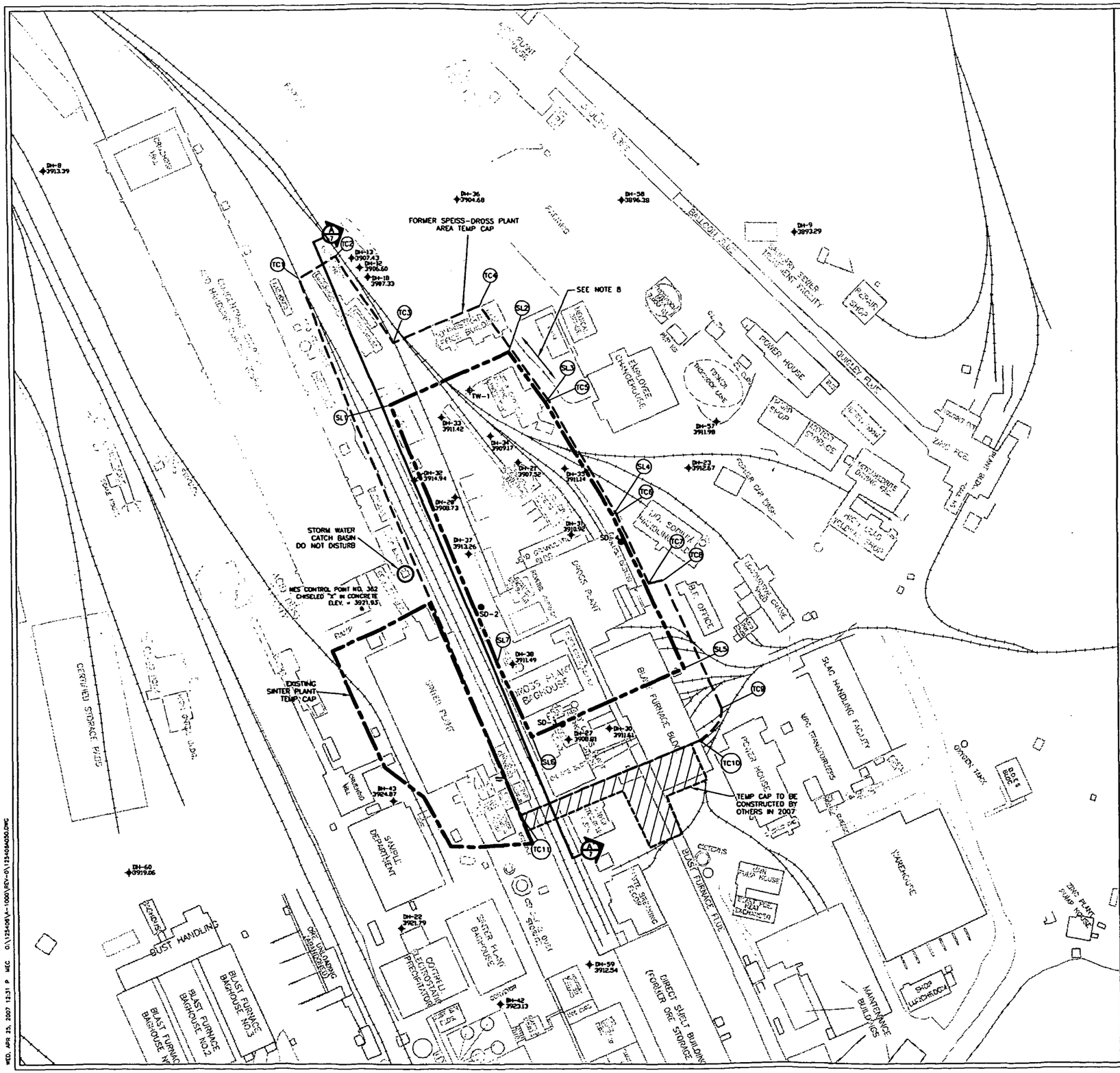


NOTES

1. THE BASIS OF BEARING IS THE ASARCO COORDINATE SYSTEM.

2. ELEVATION DATUM IS THE ASARCO VERTICAL DATUM.

3. TEMP. CAP COORDINATES ARE PROVIDE FOR GENERAL LOCATION.

4. FINAL TEMP. CAP LOCATION SHALL BE FIELD ADJUSTED TO ENSURE THAT THE CAP IS AT LEAST 5 FEET BEYOND THE SLURRY WALL AND THAT THE CAP TIES INTO THE EXISTING ADJACENT TEMP CAP(S).

5. SEE HYDROMETRICS SHEET 16 FOR GENERAL SURFACE WATER DRAINAGE FLOW IN THE CAPPED AREA.

6. SEE HYDROMETRICS SHEET 22 FOR TEMP. CAP CONNECTIONS AND DETAILS.

7. EXTEND THE ELEVEN (11) MONITORING WELLS AND ONE (1) TEST WELL LOCATED WITHIN THE CAPPED AREA TO ABOVE THE CAP, AS NEEDED. SEE HYDROMETRICS SHEET 22 FOR MONITORING WELL EXTENSION DETAIL. CONTRACTOR SHALL VERIFY SIZE AND TYPE OF WELLS.

8. THE EXISTING ROADWAY SHALL BE KEPT CLEAR FOR CONTINUOUS ACCESS TO NEARBY BUILDINGS.

SLURRY WALL CORNER COORDINATE TABLE

CORNER ID	NORTHING	EASTING
SL1	10786.50	8021.91
SL2	10853.58	8175.73
SL3	10789.47	8223.95
SL4	10641.50	8310.87
SL5	10443.57	8400.18
SL6	10353.78	8202.93
SL7	10448.16	8157.88

FORMER SREISS-DROSS PLANT AREA TEMPORARY CAP CORNER COORDINATE TABLE

CORNER ID	NORTHING	EASTING
TC1	10951.11	7904.10
TC2	10980.49	7930.58
TC3	10887.21	8026.79
TC4	10915.92	8337.81
TC5	10792.22	8228.14
TC6	10643.80	8315.32
TC7	10553.87	8355.79
TC8	10557.34	8374.59
TC9	10390.58	8448.17
TC10	10348.66	8419.75
TC11	10251.82	8186.77

LEGEND

- TW-1 — TEST WELL
- SD-2 — BOREHOLE
- DH-27 — MONITORING WELL
- A / A' — CROSS SECTION MARKER
- RAILROAD
- PROPOSED SLURRY WALL LOCATION
- FORMER SPEISS-DROSS PLANT AREA TEMPORARY CAP
- EXISTING TEMPORARY CAP AT THE SINTER PLANT
- FUTURE TEMPORARY CAP TO BE CONSTRUCTED IN 2007 BY OTHERS

REVISION	DESCRIPTION	CHECKED	APPROVED	DATE
0	ISSUED TO ASARCO, LLC	DRC	RM	04/25/07

ASARCO, LLC

ASARCO SMELTER FACILTY

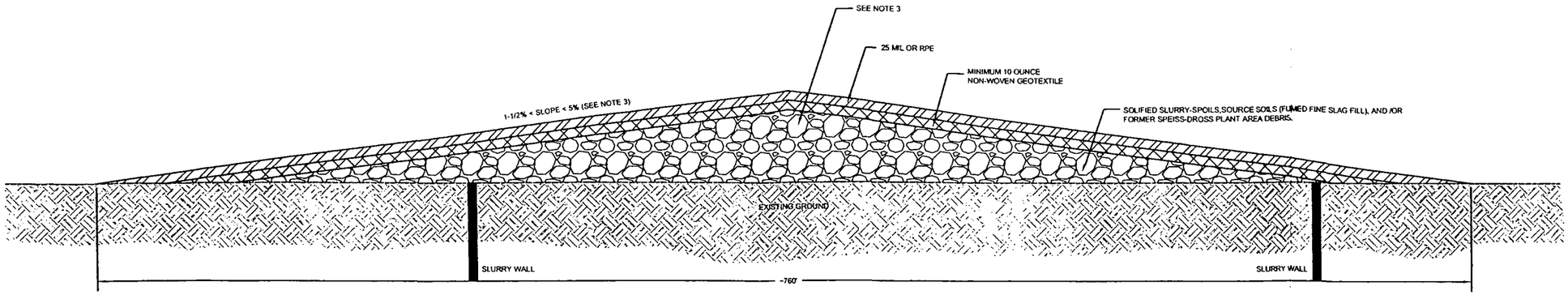
DRAWING NUMBER 6

TEMPORARY CAP LAYOUTS WITH SLURRY WALL LOCATION AND CROSS SECTION LINE A-A'

Shaw Environmental, Inc.

	BY	DATE		BY	DATE	PROJECT NO.	REV.	FILE NAME
DESIGNED	DRC	02/27/07	CHECKED	DRC	04/09/07	125406.1000	0	125406A050
DRAWN	MEC	02/27/07	APPROVED	RM	04/09/07			

WED, APR 25, 2007 12:31 P MEC O:\125406\A-1000\REV-0\125406A050.DWG



CROSS SECTION A - A'

SCALE: 1" - 30'

NOTES

1. TEMP. CAP SHALL BE CONSTRUCTED OF 25 MIL OR RPE GEOMEMBRANE AND MINIMUM 10 OUNCE NON-WOVEN GEOTEXTILE. ALTHOUGH HYDROMETERICS SHEET 22 SPECIFIES 24 MIL OR RPE, THE LINER SHALL BE 25 MIL OR RPE.

2. SEE HYDROMETRICS SHEET 22 FOR TEMP. CAP CONNECTIONS AND DETAILS. ANY OF THE EDGE DETAILS FROM HYDROMETRICS SHEET 22 COULD APPLY DEPENDING ON ACTUAL SITE CONDITIONS AROUND THE PERIMETER.

3. MAINTAIN SLOPE OF CAP NO LESS THAN 1.5 PERCENT AND NO GREATER THAN 5 PERCENT. SEE HYDROMETRICS SHEET 16 FOR SURFACE WATER DRAINAGE FLOW PATTERN FOR THE CAPPED AREA.

4. MAXIMUM AND MINIMUM HEIGHT OF THE CAP IS DEPENDENT ON MAINTAINING THE SURFACE WATER FLOW PATTERN (SEE HYDROMETRIC SHEET 16), MINIMUM SLOPE OF 1.5 PERCENT, AND A MAXIMUM SLOPE OF 5 PERCENT.

REVISION	DESCRIPTION	CHECKED	APPROVED	DATE
0	ISSUED TO ASARCO, LLC	EMC	BN	04/25/07

ASARCO, LLC

ASARCO SMELTER FACILTY

DRAWING NUMBER 7

MISCELLANEOUS DETAILS
FORMER SPEISS-DROSS
PLANT AREA

Shaw Environmental, Inc.

	BY	DATE		BY	DATE	PROJECT NO.	REV.	FILE NAME
DESIGNED	EMC	02/27/07	CHECKED	EMC	04/09/07	125406.1000	0	125406A060
DRAWN	MEC	02/27/07	APPROVED	BN	04/09/07			

WED, APR 25, 2007 12:32 P MEC O:\125406\A-1000\REV-0\125406A060.DWG

APPENDIX C

TEMPORARY CAP DESIGN

TEMPORARY CAP DESIGN

List of Specification and Sheets

Installation Specification —RPE® Geomembrane
Clarifications for Temporary Cap Design
Hydrometric, Inc. Sheet Number 15
Hydrometric, Inc. Sheet Number 16
Hydrometric, Inc. Sheet Number 22

INSTALLATION SPECIFICATION —RPE® GEOMEMBRANE

PART 1 – GENERAL

1.1 SCOPE

A. The work covered by this specification consists of the supply (and installation) of an RPE geomembrane at the locations shown on the drawings (as directed by the Owner).
B. The supply (and installation) of this liner shall be in accordance with the following references:
   1. ASTM D751-89, Standard Test Methods for Coated Fabrics.
   2. ASTM D3020-89, Standard Specification for Polyethylene and Ethylene Copolymer Plastic Sheeting for Pond, Canal, and Reservoir Lining.
   3. ASTM D4545-86(91), Standard Practice for Determining the Integrity of Factory Seams Used in Joining Manufactured Flexible Sheet Geomembranes.

PART 2 – PRODUCTS

2.1 MATERIAL CHARACTERISTICS

A. The sheeting shall be suitably formulated from first quality polyethylene materials. The geomembrane shall consist of a high strength, oriented-tape HDPE scrim coated on both sides with an impervious LDPE coating (HDPE coating for OR RPE 25). RPE materials prepared for temporary covers or other exposed application will have UV stabilizers added to the impervious coating (and may have UV stabilizers added to the scrim tapes). The RPE material shall be pigmented to produce a uniform color such as black, blue, or silver. Unpigmented materials may be used for applications that are backfilled.
B. The sheeting shall be capable of being sealed to itself using a stitched "Z" fold or heat-sealing techniques.
C. The sheeting shall be supplied in the widest widths possible to minimize fabrication seaming. Roll widths shall be not less than 3.5 m.

2.2 MANUFACTURER'S STATEMENT

A. Upon request, the manufacturer of the RPE sheeting shall submit a certification that the material meets the manufacturer's specifications. Material index quality control tests shall be performed a minimum of every 18,000 kg (40,000 lbs), once per shift, or at the start of a new material run.

2.3 MATERIAL PROPERTIES

A. The geomembrane shall be OR RPE 25 as supplied by Layfield Plastics or an approved equal. The geomembrane shall conform to the manufacturer's material properties table. All values are Typical Values unless otherwise noted.

2.4 WARRANTY

A. Contractor shall provide Owner with a warranty guaranteeing a minimum of three year satisfactory liner performance from defects and UV-degradation.

PART 3 – EXECUTION

3.1 FABRICATION

A. On all projects larger than 20,000 m^2 (200,000 ft^2), submit a panel layout in accordance with the project submittal requirements. On the panel layout, indicate the proposed arrangement of panels, fabricated seam orientation, field seam location, and anchor trench locations.
B. Individual roll widths of RPE shall be fabricated into large panels to minimize field seaming. All fabrication welds shall be a minimum of 25 mm (1 inch) wide. Heat welding techniques shall be used for shop fabrication such that all shop welds will provide a delamination of the coating from the scrim when tested. Peel testing will meet the requirements for a "Film Tear Bond" (FTB) Peel Adhesion. The minimum FTB rating shall be AD-DEL.
C. Fabrication welding shall be tested for Bonded Seam strength at a rate of three samples for every 915 lineal meters (3,000 ft) of welded seam. At the fabricator's option, one sample may be taken from each 300 lineal meters (1,000 ft) of welded seam or every 5 shop seams (whichever is greater). Seam samples will be tested for shear strength. Fabricated seam strengths shall conform to the shop seam strength values. Seams samples shall also be qualitatively tested for peel adhesion with a Film Tear Bond rating being obtained on all seams. Seams that do not meet the strength or FTB criteria are to be repaired and retested.
D. Fabricated panels shall be accordion folded in one direction and neatly rolled in the other. Each panel shall be protected with an opaque, weather resistant covering and marked with panel dimensions and unfolding directions. All panels shall be delivered and stored in a protected area until ready for installation.

3.2 INSTALLATION

A. Prepared surfaces shall be smooth and free of sharp objects, rocks, and organics (roots). If a suitable subgrade is not available then 100 mm (4 inches) of clean sand, and a 10 ounce geotextile shall be placed prior to liner installation (subject to site conditions). A 10 ounce geotextile shall be placed under the liner in all areas.
B. Installation shall be performed in a logical sequence by an installer/contractor experienced in lining installations.
C. Place panels according to the drawings and the panel layout. Sufficient thermal slack shall be incorporated during placement to ensure that harmful stresses do not occur in service. Distribute slack wrinkles evenly.
D. All field seams shall be tightly bonded using tape seaming technology. Six inch wide polyisobutylene-butyl sealant tape shall be used at penetrations and for all field seams.
E. Full contact between the tape and the material will be the standard of acceptance.
F. All field seams shall be non-destructively tested along their entire length using the Air Lance Test (ASTM D4545) or the Mechanical Point Stress Test (ASTM D4545). Patches and seams around pipe penetrations and fitments shall be tested using the Point Stress Test (ASTM D4545). All discontinuities detected by any test method shall be repaired.
G. Repairs shall utilize the same material as the geomembrane, or a material compatible with the geomembrane, and shall extend a minimum of 300 mm (12 inches) beyond the defect. Repairs shall be accomplished with tape seaming techniques utilizing a tape appropriate to existing site conditions. All repairs are to be tested using Air Lance or Mechanical Point Stress methods as applicable (ASTM D4545).

H. Protect the geomembrane from wind uplift during installation through the use of sand bags or other suitable weights. Backfill anchor trenches and place design backfill on geomembrane as soon as practical. Placement of backfill should be monitored continuously, and any damaged areas repaired and tested.

I. Shingle RPE seams in the direction of water flow as applicable. If possible, backfill in the direction of flow to prevent application of stresses to field seams.

J. Pipe Boots. Fit and seal pipes, well casings, manholes, and other penetrations of the geomembrane with shop fabricated boots as shown on the Drawings. Match the flange portion of the boot to the angle of the slope or bottom where the pipe or manhole enters the liner for a smooth fit without excess stretching of the material.

END OF SECTION

CLARIFICATIONS FOR TEMPORARY CAP DESIGN

Clarification #1 - RPE® Geomembrane

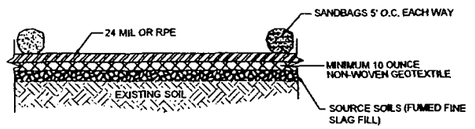
The clarification for the conflict between Note 4 on Hydrometrics Sheet 16 and the Installation Specification —RPE® Geomembrane of this Appendix C regarding the seaming requirements is that seams shall be sewn. Note 4 on Sheet 16 states that the seams must be sewn. The Installation Specification – RPE Geomembrane states that the seams can be either sewn or taped. This clarification states that for the construction of the Temporary Cap at the former Speiss-Dross Plant area, the RPE geomembrane seams shall be sewn and taping will not be allowed.

Clarification #2 – Clean Sand Substitute

Slag may be substituted for clean sand for subgrade preparation as specific in the Installation Specification —RPE® Geomembrane, Paragraph 3.2 (A).

Clarification #3 – Final Grade Flow Pattern

The importance of the final grade flow pattern will be discussed in further detail at the pre-bid conference.



1/22 DETAIL
TEMP CAP
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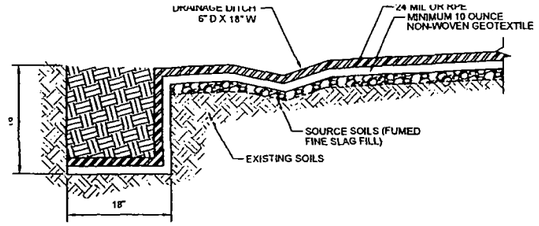
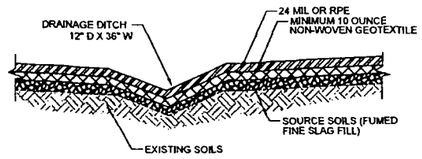


2/22 DETAIL
LINER ANCHOR TRENCH WITH DRAINAGE DITCH
SCALE: NTS



3/22 DETAIL
LINER DRAINAGE DITCH (TYP)
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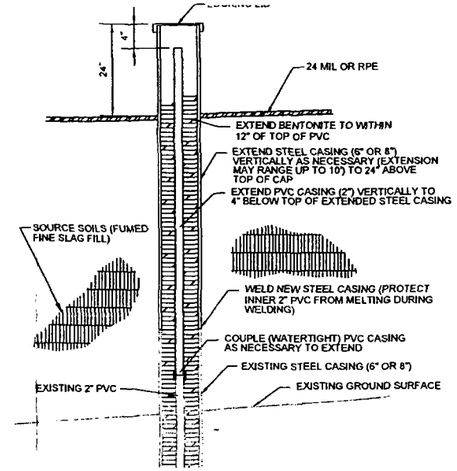

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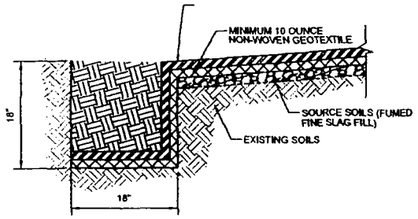
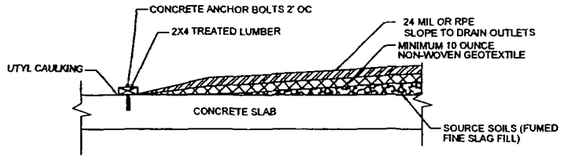
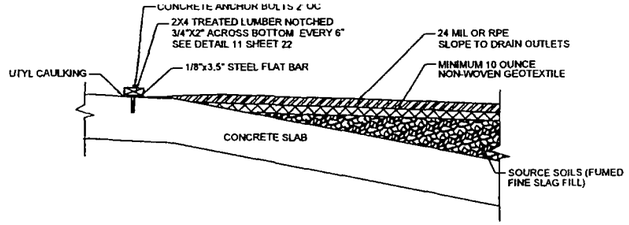


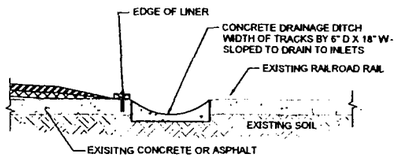
4/22 DETAIL
LINER ANCHOR TRENCH
SCALE: NTS



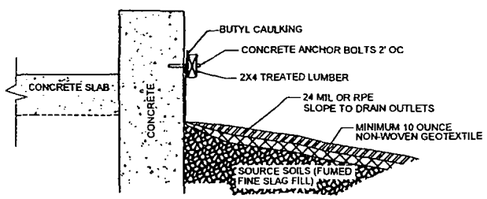
5/22 DETAIL
LINER CONCRETE ANCHOR
SCALE: NTS



6/22 DETAIL
RUN-ON LINER/CONCRETE ANCHOR
SCALE: NTS



7/22 DETAIL
CONCRETE DRAINAGE DITCH
SCALE: NTS



8/22 DETAIL
LINER WALL/FOUNDATION ANCHOR
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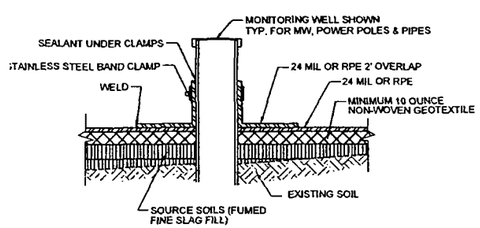

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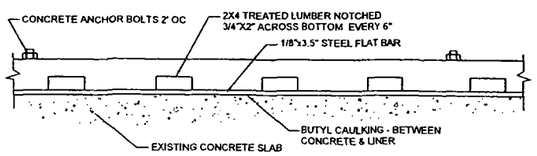

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RUN-ON ANCHOR DETAIL
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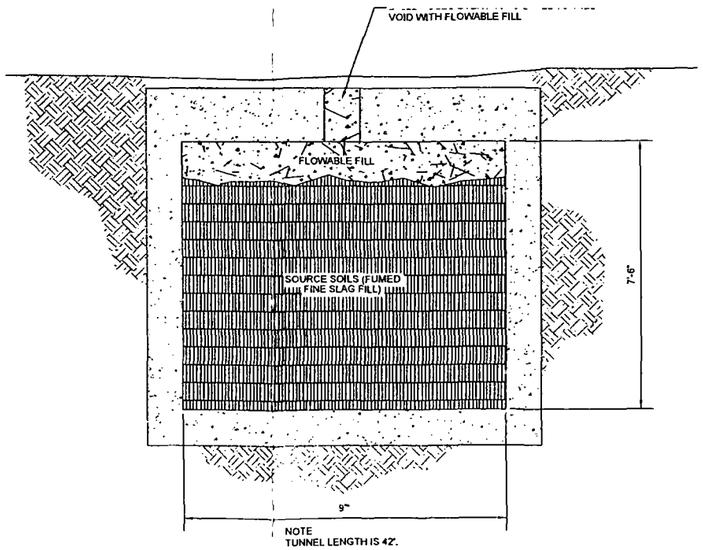

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REVISIONS

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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

Project No.: 6052

DRAWN BY	JSD	1/19/07
CHECKED BY	MWR	1/23/07
APPROVED BY	MJO	1/24/07
SCALE: AS NOTED		

Hydrometrics, Inc.
Consulting Scientists and Engineers
Helena, Montana 59601
3020 Bozeman Avenue
(406) 443-4150

ASARCO LLC - EAST HELENA PLANT
2007 CLEANING & DEMOLITION PROJECT
DETAILS

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AUTOCAD 2004 DRAWING (DWG)
SHEET NUMBER: 22
REV: 1

UPDATE TIME: 3:44PM
JSD \\HEL\DATA\V\Land Projects\605202\Dwg\605202H022.dwg

AREA 4 (1)

AREA 1 (1)

AREA 3 (1)

AREA 2 (1)

NOTES FOR TEMP. CAP AT FORMER SPEISS-DROSS PLANT AREA

1. AT EXISTING TEMP. CAP AREA 1, REMOVE LINER AND SLAG BEFORE CONSTRUCTING SLURRY WALL PER SPECIFICATION.
2. CONSTRUCT NEW AND/OR REPLACE TEMP CAP OVER AREAS 1 AND 4 AFTER COMPLETION OF THE SLURRY WALL. SEE SHAW DRAWING 6 FOR APPROXIMATE LOCATION OF TEMP CAP.
3. TIE NEW TEMP CAP LINER (AT AREA 4) INTO EXISTING TEMP CAP AT AREA 2.
4. TEMP CAP AT AREA 3 WILL BE CONSTRUCTED BY OTHERS IN 2007. IF THE AREA 3 TEMP CAP IS COMPLETED AT THE TIME FOR TEMP CAP CONSTRUCTION THEN TIE AREA 4 TEMP CAP INTO THE TEMP CAP AT AREA 3.
5. SOURCE DRAWING PROVIDED BY HYDROMETRICS.
6. (1) NOTES ADDED IN APRIL 2007 FOR FORMER SPEISS-DROSS PLANT AREA TEMP CAP DESIGN.

(1)

LEGEND

- 2007 ADDITIONAL DEMOLITION AND RACK
- EXISTING STRUCTURES
- 2006 TEMPORARY CAP
- 2007 TEMPORARY CAP
- 2007 ADDITIVE ALTERNATIVE 'A' TEMPORARY CAP
- 2007 ADDITIVE ALTERNATIVE 'B' TEMPORARY CAP
- 2007 TEMPORARY CAP - TO BE DONE BY OTHERS
- SURFACE WATER DRAINAGE INLET AREAS (GRAVITY FLOW)

NORTH

SCALE
Or Feet
90 0 90 180 360

NO	BY	DATE	DESCRIPTION
1	JSD	04/2007	EXTENDED TEMPORARY CAP BY OTHERS

SCALE VERIFICATION BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NO.: 5052
DRAWN BY: JSD 1/19/07
CHECKED BY: MWR 1/19/07
APPROVED BY: MJD 1/19/07
SCALE: 1"=90'

Hydrometrics, Inc.
Consulting Scientists and Engineers
Helena, Montana 59601

ASARCO LLC - EAST HELENA PLANT
2007 CLEANING & DEMOLITION PROJECT
TEMPORARY CAP PHASE IV - PLAN

DRAWING FILE NUMBER: 805203H015.dwg
SHEET NUMBER: 15
REV: 1

NOTES:

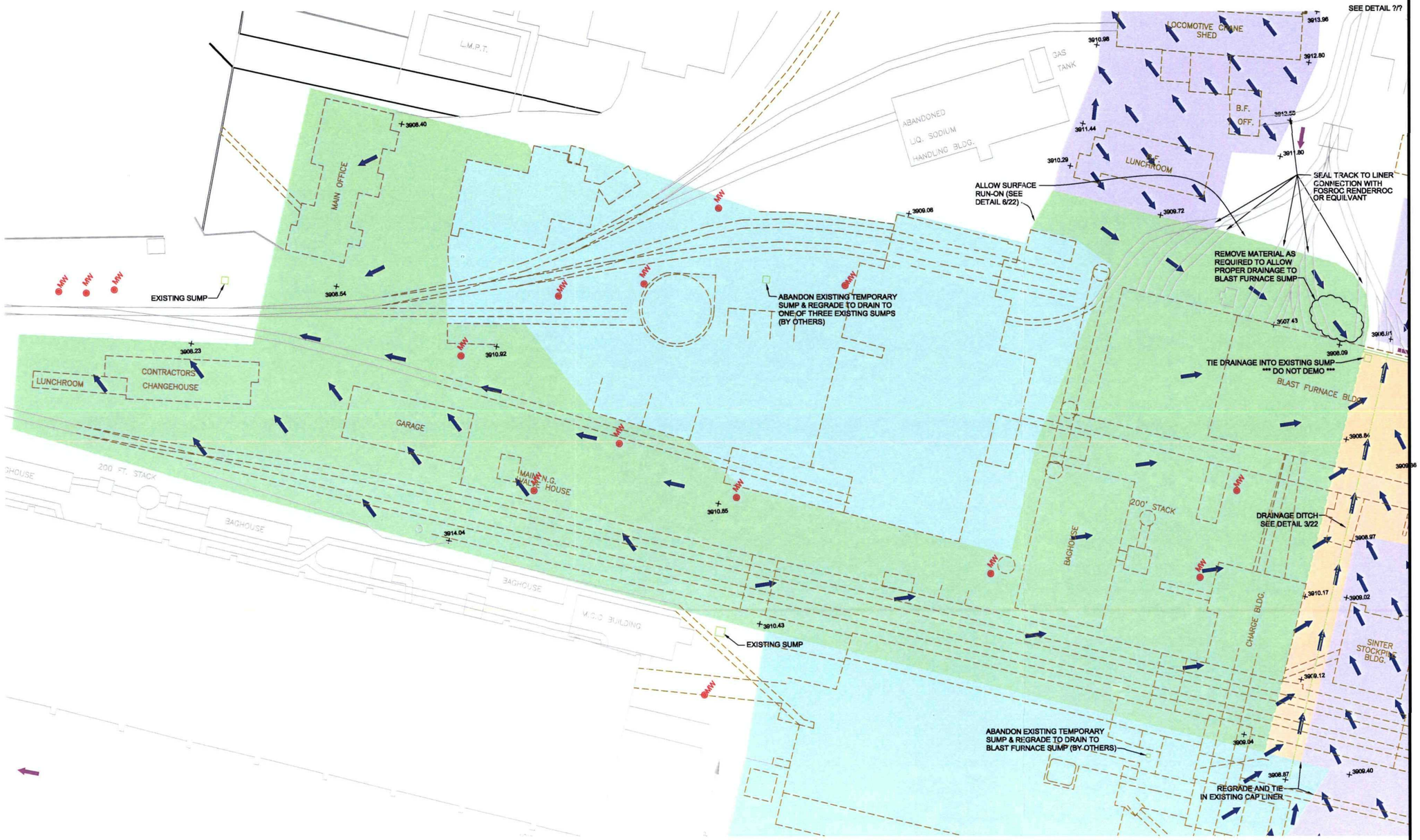
1. PREPARE SUBGRADE BY REMOVING ANY EXPOSED METAL OR SHARP OBJECTS.
2. USE FUMED FINE SLAG OR OTHER MATERIAL SUITABLE AS ON-SITE BORROW TO BRING LOW AREAS AND DEPRESSIONS UP TO A GRADE THAT ENSURES DRAINAGE OF THE CAP TO THE SITE STORMWATER DRAIN SYSTEM.
3. OVERLAP NON-WOVEN GEOTEXTILE A MINIMUM OF 12 INCHES.
4. Z-FOLD AND STITCH REINFORCED POLYETHYLENE (RPE) GEOMEMBRANE AT ALL SEAMS.
5. *IN AREAS WHERE LINERS WILL BUTT AGAINST CONCRETE* FOUNDATIONS ATTACH WITH 2"X4" TREATED TIMBERS WRAPPED WITH AT LEAST ONE FULL WRAP IN THE LINER AND ANCHORED TO THE CONCRETE WITH CONCRETE ANCHOR BOLTS AS ADDITIONAL SUPPORT USE A SIKA-FLEX CAULK TO SEAL BETWEEN THE LINER AND THE CONCRETE.
6. CONTRACTOR IS RESPONSIBLE FOR THEIR OWN QUANTITY ESTIMATES AND NUMBERS PROVIDED ON PLANS ARE FOR INFORMATION ONLY.
7. COMPLETE MONITORING WELL EXTENSIONS IN ACCORDANCE WITH MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION (MDNRC) MONITORING WELL REGULATIONS AND BY A LICENSED MONITORING WELL CONSTRUCTOR.
8. COMPLETE LINER JUNCTIONS AT MONITORING WELLS, POWER POLES, AND WATER LINES ACCORDING TO DETAIL 9/22.
9. GRADE TRANSITIONS BETWEEN EXISTING 2006 TEMPORARY CAP AND 2007 TEMPORARY CAP LINERS SO THAT WATER IS ABLE TO FLOW IN THE DIRECTION SHOWN WITHOUT PONDING. OVERLAP TRANSITIONS AS DESCRIBED IN NOTES 3 AND 4.
10. ENSURE CAP GRADE EXCEEDS 1.5%. CAPS EXCEEDING GRADES OF 30% REQUIRE CONTINUOUS LINES OF SANDBAGS ON 5' SPACING.

NORTH

SCALE
(In Feet)
30 0 30 60 90

LEGEND

- 2007 AND PRIOR DEMOLITION WORK
- EXISTING STRUCTURES
- 2006 TEMPORARY CAP
- 2007 TEMPORARY CAP
- 2007 ADDITIVE ALTERNATIVE "A" TEMPORARY CAP
- 2007 ADDITIVE ALTERNATIVE "B" TEMPORARY CAP
- 2007 TEMPORARY CAP- TO BE DONE BY OTHERS
- MW MONITORING WELL - DO NOT DEMO
- SURFACE WATER DRAINAGE INLET AREAS (GRAVITY FLOW)
- SURFACE WATER DRAINAGE FLOW IN CAPPED AREAS
- SURFACE WATER DRAINAGE FLOW IN UNCAPPED AREAS
- +3908.54 SURVEY POINTS (EXISTING GROUND ELEVATIONS)



REVISIONS	NO	BY	DATE	DESCRIPTION
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

Project No.: 6052		
DRAWN BY	JSD	1/17/07
CHECKED BY	MWR	1/19/07
APPROVED BY	MJO	
SCALE: 1"=30'		

Hydrometrics, Inc.
Consulting Scientists and Engineers
Helena, Montana 59601
3020 Bozeman Avenue
(406) 449-5190

ASARCO LLC - EAST HELENA PLANT
2007 CLEANING & DEMOLITION PROJECT
TEMPORARY CAP PHASE IV - STAGE 1

DRAWING FILE NUMBER: 605202H016.dwg
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SHEET NUMBER: 16
REV: 1

UPDATE TMP: 3:16PM

APPENDIX D

SOIL BORINGS

Hydrometrics, Inc.

Consulting Scientists and Engineers
Helena, Montana

Soil Boring Log

Hole Name: SD-2

Date Hole Started: 9/21/06 Date Hole Finished: 9/21/06

Client: ASARCO, INC.
Project: Interim Measures East Helena Facility
County: Lewis and Clark State: Montana
Property Owner: Asarco Inc.
Legal Description:
Location Description:

Recorded By: Greg Lorenson

Drilling Company: Boland Drilling
Driller: Rick & Chuck
Drilling Method: Air Rotarry/ODEX
Drilling Fluids Used: Air/Water
Purpose of Hole: Collect Soil Samples
Hole Diameter (in): 4
Total Depth Drilled (ft): 36.5

Remarks:

DEPTH	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE TIME	NOTES	GRAPHICS	GEOLOGICAL DESCRIPTION
	01	GRAB		0.5 - 5.0'		0.0 - 0.5' **Asphalt** Asphalt 0.5 - 5.0' **Gravely Sand** Dark brown, fine to coarse grained sand with gravel. Trace of fines
5	02	GRAB		5.0 - 7.5'		5.0 - 7.5' **Sandy Gravels** Dark gray, fine to coarse gravels with redish brown fine to coarse grained sand.
	03	GRAB		7.5 - 10.0'		7.5 - 10.0' **Cobbles and gravels** Large basalt cobbles and coarse gravels with redish brown fine to coarse grained sand
10	04	GRAB		10.0 - 12.5'		10.0 - 12.5' **Sandy Gravels** Dark gray fine to coarse gravels with redish brown coarse grained sand. Trace cobbles
	05	GRAB		12.5 - 15.0'		12.5 - 15.0' **Cobbles and gravels** Dark gray, fine to coarse gravels with large basalt cobbles and bolders. Some fine to coarse grained sand.
15	06	GRAB		15.0 - 17.5'		15.0 - 20.0' **Gravely Sand** Redish brown, fine to coarse grained sand with 5% fine grained basalt gravels Wet at 18'
	07	GRAB		17.5 - 20.0'		
20	08	GRAB		20.0 - 22.5'		20.0 - 30.0' **Sandy Gravel** Redish brown fine to coarse grained sand with 45% coarse gravels and some small cobbles (basalts and rhyolite). Slight petroleum odor at 23'.
	09	GRAB		22.5 - 25.0'		
25	10	SS		25.0 - 27.5'		
	12	GRAB		27.5 - 30.0'		
30	13	SS		30.0 - 31.0'		30.0 - 35.5' **Cobbles and Gravels** Dark gray basalt cobbles and coarse gravels with small layer of sand at 35'
	14	GRAB		32.5 - 35.0'		
35	15	GRAB		35.0 - 35.5'		
	16	SS		35.5 - 36.5'		35.5 - 36.5' **Ash** Yellow/Green with black inclusions volcanic ash. Silty texture
40						

SOIL_BORE_REV1 K:\GINT\PROJECTS\1054.GPJ HYDHLN2.GDT 1/2/07

Hydrometrics, Inc.

Consulting Scientists and Engineers
Helena, Montana

Soil Boring Log

Hole Name: SD-3

Date Hole Started: 9/20/06 Date Hole Finished: 9/20/06

Client: ASARCO, INC.
Project: Interim Measures East Helena Facility
County: Lewis and Clark State: Montana
Property Owner: Asarco Inc.
Legal Description:
Location Description:

Recorded By: Greg Bryce

Drilling Company: Boland Drilling
Driller: Rick & Chuck
Drilling Method: Air Rotarry/ODEX
Drilling Fluids Used: Air/Water
Purpose of Hole: Collect Soil Samples
Hole Diameter (in): 4
Total Depth Drilled (ft): 31

Remarks:

DEPTH	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE TIME	NOTES	GRAPHICS	GEOLOGICAL DESCRIPTION
						0.0 - 0.5' **Concrete** Concrete Slab with rebar
	01	GRAB		2.0 - 5.0'		2.0 - 5.0' **Boulders and Cobbles** Dark gray basalt boulders and cobbles with some sand and gravels. Hard drilling.
5	02	GRAB		5.0 - 7.0'	5	5.0 - 7.0' **Sandy Gravels** Gray/Tan, fine to coarse, sub-angular gravels with 30%-35% medium to coarse grained sand.
	03	GRAB		7.0 - 9.0'		7.0 - 11.0' **Gravely Sand** Brown fine to coarse grained sand with 20% fine to coarse basalt gravels. Some cobbles 10'. Wet at 10'.
10	04	SS		10.0 - 11.0'	10	
						11.0 - 12.0' **Boulders and Cobbles** Large basalt boulders and cobbles
	05	GRAB		13.0 - 15.0'		13.0 - 15.0' **Gravely Sand** Redish brown, fine to coarse grained sand with 10-15% fine to coarse basalt gravels. Gray petroleum odor and staining at 14'.
15	06	SS		15.0 - 16.5'	15	15.0 - 16.5' **Silty, Sandy Gravel** Gray, mostly coarse w/ some fine basalt gravel. 10% silt, and 10% fine to coarse grained sand, trace of clay. Petroleum staining throughout.
	07	GRAB		17.0 - 19.0'		17.0 - 19.0' **Gravely Sand** Gray, fine to coarse grained sand with 20% fine gravels. Petroleum odor.
20	08	SS		20.0 - 21.5'	20	20.0 - 26.0' **Sandy Gravels** Gray/Brown/Redish Brown, fine to coarse, sub-rounded gravels with 30-35% fine to coarse grained sand and trace of silt. Petroleum staining
25	09	SS		25.0 - 26.0'	25	
	10	GRAB		26.0 - 28.0'		26.0 - 28.0' **Cobbles and Gravels** Dark gray coarse basalt gravels and cobbles. Trace Sand. Hard drilling
30	11	SS		29.0 - 31.0'	30	29.0 - 31.0' **ASH** Volcanic Ash; Whitish Tan, silty clay in texture. Black inclusions.
35					35	

SOIL BORE REV1 K:\GINT\PROJECTS\1054.GPJ HYDHLN2.GDT 1/2/07

Hydrometrics, Inc.

Consulting Scientists and Engineers
Helena, Montana

Soil Boring Log

Hole Name: SD-4

Date Hole Started: 9/22/06 Date Hole Finished: 9/22/06

Client: ASARCO, INC.
Project: Interim Measures East Helena Facility
County: Lewis and Clark State: Montana
Property Owner: Asarco Inc.
Legal Description:
Location Description:

Recorded By: Greg Lorenson

Drilling Company: Boland Drilling
Driller: Rick & Chuck
Drilling Method: Air Rotarry/ODEX
Drilling Fluids Used: Air/Water
Purpose of Hole: Collect Soil Samples
Hole Diameter (in): 4
Total Depth Drilled (ft): 36

Remarks:

DEPTH	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE TIME	NOTES	GRAPHICS	GEOLOGICAL DESCRIPTION
						0.0 - 1.0' **Concrete** Concrete
						1.0 - 5.0' **Sandy Cobbles and Boulders** Dark gray cobbles and boulders (basalt) with 30% red/brown, fine to coarse grained sand
5	1	GRAB		5.0 - 10.0'	5	5.0 - 10.0' **Sandy Gravel** Dark gray, fine to coarse gravels with poorly sorted fine to coarse grained sand. Boulder at 5-8'
10	2	GRAB		10.0 - 15.0'	10	10.0 - 15.0' **Gravely Sand** Redish brown, poorly sorted, fine to coarse sand with 20% gravels
15	3	GRAB		15.0 - 17.5'	15	15.0 - 17.5' **Cobbles and Gravels** Dark gray cobbles with fine to coarse grained gravels
	4	GRAB		17.5 - 20.0'		17.5 - 19.0' **Gravely Sand** Redish brown, coarse grained sand with 30 - 40% gravels Moist
20	5	SS		20.0 - 20.5'	20	19.0 - 22.5' **Gravely Sand** Gray, fine to coarse grained sand with 30% fine to coarse gravel. Wet @ 20'
	6	GRAB		20.5 - 22.5'		
	7	GRAB		22.5 - 25.0'		22.5 - 27.5' **Sandy Gravels** Gray fine to coarse gravels with coarse sand and some silt. Cobbles at 25' Petroleum staining.
25	8	SS		25.0 - 27.5' Sample SD-4-08b was grab sample of same interval of SS.	25	
	9	GRAB		27.5 - 30.0'		27.5 - 30.0' **Sandy Gravels** Dark gray, fine to coarse gravels with redish brown coarse grained sand.
30	10	SS		30.0 - 30.5'	30	30.0 - 33.5' **Cobbles and Gravels** Dark gray cobbles and coarse gravels. Some fine grained sand and silt present @ 33'.
	11	GRAB		30.5 - 32.5'		
	12	GRAB		32.5 - 34.0'		
35	13	SS		34.0 - 36.0'	35	33.5 - 36.0' **Ash** Whitish tan Volcanic Ash. Silty Clay in texture with black inclusions (hornsblend).
40					40	

SOIL_BORE_REV1 K:\GIN\PROJECTS\1054.GPJ HYDHLN2.GDT 1/2/07

Hydrometrics, Inc.

Consulting Scientists and Engineers
Helena, Montana

Test Well

Hole Name: TW-1

Date Hole Started: 8/4/06 Date Hole Finished: 8/7/06

Client: ASARCO, INC.
Project: Interim Measures East Helena Facility
County: Lewis and Clark State: Montana
Property Owner: Asarco Inc.
Legal Description:
Location Description:

Recorded By: WRT/JLC
Drilling Company: Woodward/Boland
Driller: James / Brian
Drilling Method: Air Rotary
Drilling Fluids Used: Water
Purpose of Hole: Groundwater Capture Test Well
Target Aquifer: Shallow Alluvial
Hole Diameter (in): 8
Total Depth Drilled (ft): 43

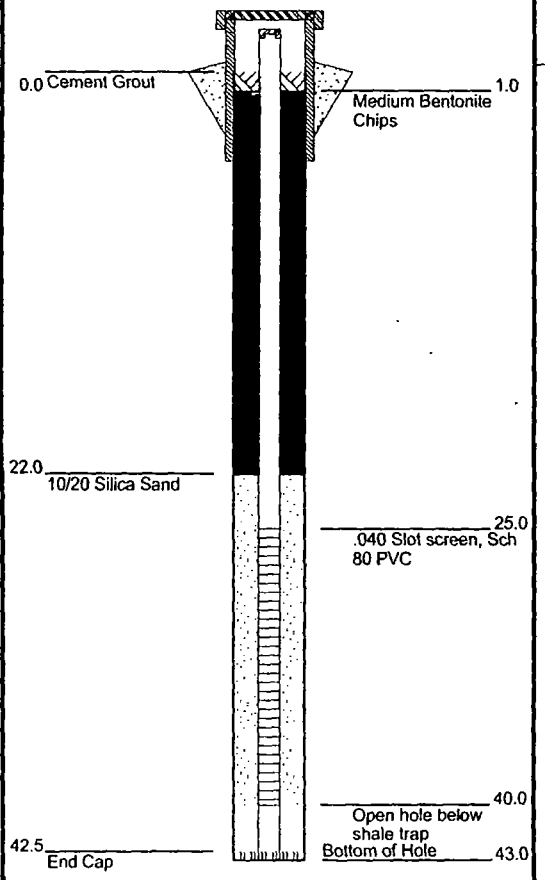
WELL COMPLETION	Y/N	DESCRIPTION	INTERVAL
Well Installed?	Y	4.5", bell joint, Sch 80, PVC	+2.5-43
Surface Casing Used?	Y	6" Steel	+3 to -2
Screen/Perforations?	Y	0.040- inch, Sch 80	25-40
Sand Pack?	Y	1020 Silica Sand	22-40
Annular Seal?	Y	Bentonite Pellets	1 - 22 pellets
Surface Seal?	Y	Cement	0-1
DEVELOPMENT/SAMPLING			
Well Developed?	Y	pumping	
Water Samples Taken?	N		
Boring Samples Taken?	N		

Northing: Easting:
Static Water Level Below MP: 28.59
Date: 8/9/06
MP Description: Top of Casing
MP Height Above or Below Ground (ft):

Surface Casing Height (ft): 2.5
Riser Height (ft): 3.0
Ground Surface Elevation (ft):
MP Elevation (ft):

Remarks: Water encountered at 25' depth.

WELL CONSTRUCTION



SAMPLE NOTES

GRAPHICS

GEOLOGICAL DESCRIPTION

0.0 - 5.0' **Sandy Silt with Gravel**
Light brown sandy silt with some gravel

5.0 - 9.0' **Silty, Sandy Gravel**
Light brown silty, sandy gravel. Some cobbles and boulders.
Difficult Drilling. Boulder at 9' causing difficulty with drilling.

17.0 - 18.0' **Silty, Gravelly Sand**
Brown silty, gravelly sand with some cobbles and boulders.
Hard Drilling.

20.0 - 25.0' **Gravel**
Sandy 2" angular gravel.
Black to gray hydrocarbon staining and strong odor at 23' to depth of hole.
Water at 25'.

25.0 - 30.0' **Sand and Gravel**
Black (stained) sand and gravel with hydrocarbon odor.

30.0 - 40.0' **Sand and Gravel**
Black (stained) sand and gravel. Up to 3" rounded, gravel and few cobble.

40.0 - 45.0' **Ash**
Tan clayey silt (Ash), stained on exterior of chunks washing out. Some sand and gravel as above likely falling in from above. Driller noted easy drilling starting at 40'.

45.0 - 47.0' **Ash**
Same as above.

STANDARD REV4 K:\GINT\PROJECTS\1054.GPJ HYDHLN2.GDT 1/3/07

APPENDIX E

BENCH SCALE LABORATORY RESULTS SUMMARY

NOTES FOR THE BENCH SCALE TESTS

The memoranda prepared for the Compatibility Tests, the Soil-Bentonite Design Mixture, and Long Term Permeability Testing inadvertently referenced that the source of the production water was collected from the Upper Lake. The actual source of the production water for bench scale tests was from the city of East Helena, Montana municipal water supply. All future bench scale test memoranda prepared after April 2007 will correctly identify that the production water source is from the city of East Helena.

COMPATIBILITY TESTS

Memorandum from Geo-Solutions

Date: 3/13/07
To: Russ Morgan, Elaine Coombe, Shaw
From: Steve Day, Geo-Solutions
Via: email

Subject: Compatibility Testing for Slurry Cutoff Wall, Speiss-Dross Site, East Helena, MT

Russ and Elaine:

This is the first in a series of memos to report to you on the progress of our efforts to complete a laboratory design mix program to develop a compatible and low permeability mixture of materials to serve as the backfill for a slurry wall at the Speiss-Dross Plant Site of Asarco in East Helena, MT. When this design mix effort is complete, we will compile and summarize the data from these memos into a final report.

Our participation in this project is provided in accordance with Shaw Purchase Order No. 264535 OP of 2/26/07 for this work. This memo presents the test results we have obtained to this date and our plans for the next phase the work.

Outline of Testing Program

This laboratory study is being enacted to pre-determine the compatibility of the slurry wall materials and determine the optimum amount of additives to use in the slurry wall to provide a groundwater barrier with a hydraulic conductivity (or permeability) of 1×10^{-7} cm/sec or less.

Due to the uncertainty in compatibility and the need to act quickly, two types of slurry wall materials are being considered; soil-bentonite (SB), and soil-cement-bentonite (SCB). SB slurry walls generally provides the lowest permeability barrier, while SCB is slightly more permeable, but sometimes more resistant to some contaminates.

The testing program is designed to be completed in phases as follows:

1. Characterize available site materials, i.e. slurry mixing water, potential trench spoils, and borrow materials.
2. Perform index tests for compatibility with commercial clays (e.g. bentonite) and the site groundwater. The objective of these tests is to quickly eliminate any additives

which indicate a potential incompatibility with the groundwater. The principals of Geo-Solutions are among those who developed these special tests.

3. Perform index tests for compatibility with cement grouts (e.g. cement-bentonite) and the site groundwater. The objective of these tests is to eliminate any grouts which demonstrate a potential incompatibility with the groundwater. For this project, Phase 2 and 3 are being performed simultaneously.
4. Formulate and test a number of trial SB and/or SCB mixtures and test these mixtures for permeability to tap water. The objective of these tests is to develop a mixture with a low permeability using the materials developed in Phases 1, 2 and 3.
5. Formulate and test the best mixtures from Phase 4 for permeability to the site groundwater. In order to fully document our success, the mixtures tested in Phase 5 are subjected to at least 2 pore volumes of permeation with the site groundwater. It has been our experience that this phased approach guarantees a successful mixture.

Laboratory

Laboratory testing is being completed by Advanced Terra Testing (ATT) of Lakewood, CO under the direction of Steve Day of Geo-Solutions. ATT is fully qualified, licensed and experienced to perform all type of soil and rock testing including tests with radioactive and hazardous materials. The contact at ATT is Kerry Repola at 303-232-8308. Mr. Day and ATT have worked together on this type of testing on numerous previous projects, including the Former Acid Plant Sediment Drying Area slurry wall in 2006.

Standards and Methods

The standards and methods to be employed in the design mix are listed in the table below.

Test	Standard or Reference
Grainsize	ASTM D422
Fines Content	ASTM D1140
Atterberg Limits	ASTM D4318
Moisture Content	ASTM D2216
Soil Classification (USCS)	ASTM D2487
Water Quality (ph, Hardness, Alkalinity, TDS)	Hach Test or equal
Slurry Preparation	API 13A mod.
Soil-Cement sample preparation	ASTM D4832
Slump (mini-slump method)	ASTM D143 mod.
Viscosity and Density	API RP 13B-1
Filtrate, pH, and temperature	API RP 13B-1
Bleed and Set	ASTM C940 mod.
Penetration Resistance	ASTM D1558 mod.
Accelerated Cure	ASTM D684 mod.
Unconfined Compression Strength	ASTM D1633 & D2166
Hydraulic Conductivity (permeability)	ASTM D5084
Hydraulic Conductivity: Long Term	ASTM D7100
Pan-Set	CRA, June 1991

Slake / Immersion	ASTM C267 & D4644 mod.
Chemical Desiccation	Alter et. al. 1984
Sedimentation / Flocculation	Ryan 1987
Long-term Filtrate w / leachate	D'Appolonia 1980

Phase 1 Testing – Site Resources

We consider the available site resources to include the slurry mixing water, trench spoils, and borrow materials. Samples of these materials were recently provided by Asarco and received at the laboratory. Four borings were sampled by Asarco. In the laboratory we made a composite from the soils from each boring. In making the composites, we included a conservative bias by excluding portions of the key material, volcanic tuff, in the composites since this is the best material for creating low permeability. The volcanic tuff is also expected to be less than 10% of the SB backfill (3 ft in 35 ft depth). The grain size and water content of the composite soils are summarized in the table below.

Boring Number	**TW-1**	**SD-2**	**SD-3**	**SD-4**	**EHLN**
Water Content	7%	8%	9%	9%	15%
Grain size					
Max Particle	>3/4"	>1.5 "	>3/4 "	>1.5 "	-
>#4	52%	70%	57%	68%	-
>#40	21%	13%	20%	17%	-
>#200	11%	7%	10%	8%	61%
Classification	SW	SW	SW	SW	CL

All of the composites are lacking in adequate fines for a soil-bentonite (SB) slurry wall backfill. However, the borrow soil, EHLN has more than adequate fines and will be mixed with the composite soils to provide adequate fines content in the SB mixtures.

The waters received at the laboratory from Asarco are the groundwater from monitoring well TW-1 and Upper Lake water. Upper Lake water was used successfully as the mixing water in the 2006 project at the Former Acid Sediment Drying Area project. The groundwater is known to be contaminated with arsenic. The properties of the waters, measured in the laboratory are summarized in the table below:

Designation	**Upper Lake**	**Groundwater**
Use	mix water	groundwater
pH	5 to 6	9 to 10
Hardness	120	50
Alkalinity	80	>240
TDS	500	0-500

Phase 2 Testing – Clay Compatibility via Index Tests

Two commercial clays were subjected to compatibility testing with the groundwater: API bentonite (Hydrogel 90) and salt resistant bentonite (SR bentonite or SW 101). The API bentonite is representative of the most common slurry wall material. SW 101 is a specially treated bentonite clay, most often used in off-shore drilling and typically mixed with salt water. The properties of the slurries with the Upper Lake water are shown in the table below.

Property	Bentonite	SR Bentonite
B/W (by weight)	6.00%	4.25%
Viscosity (MF seconds)	47	54
Filtrate (ml/ 30 min.)	10.3	5.3
Density (pcf)	65	64.5
pH	7.5	8

Index-type compatibility tests are performed with the clay slurries to detect potential gross incompatibility or other reaction between the slurries and site groundwater. The tests are performed by first creating a standard slurry from Upper Lake water and the clay. The SR bentonite was mixed at a lower proportion (4.5 vs 6%) than the API bentonite, because it makes a much thicker slurry. Properties of both slurries are acceptable with the Upper Lake water.

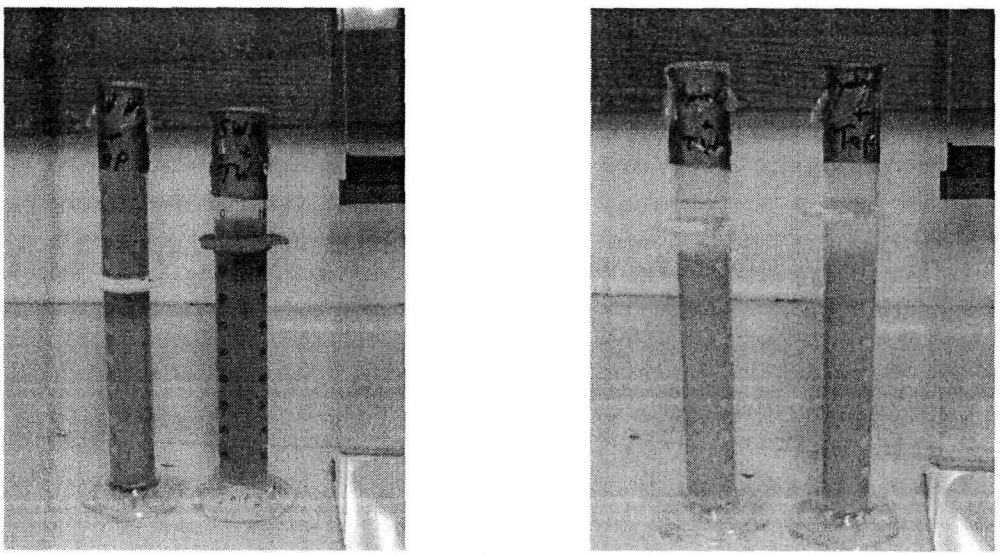
Sedimentation/flocculation tests are performed to help determine whether the clay will fall out of suspension in the presence of the groundwater during construction. Slurries are made with each of the clays and diluted 1:1 with tap water and groundwater. The slurries are poured into graduate cylinders and then observed for at least 7 days. Comparisons are made between slurries diluted with tap water and groundwater.

Chemical desiccation tests are performed to help determine if the groundwater affects the chemical structure of the clay. Slurries are made with each of the clays, as previously described and diluted at a 1:1 with tap and groundwater. These mixtures are poured onto glass plates and allowed to dry. The cracking pattern of the dried slurry is then examined for any unusual patterns. Comparisons are made between slurries diluted with tap water and groundwater.

Filter press permeability tests are performed to help determine if the groundwater will degrade the filter cake of the commercial clay. The test is performed by first completing two standard filtrate tests (30 minutes at 100 psi) with each of the clay slurries. Next, the supernate from each test is decanted and the two cells (with filter cakes still intact) are refilled one with tap water and one with groundwater. The test cells are again pressurized (at 100 psi) and the test continued for about 3 hours while the flow rate of the waters through the two filter cakes is monitored. The flow rates can be compared as the ratio of the filtrate of the groundwater to the filtrate of the tap water verses the pore volumes of flow. A ratio where the groundwater flows through the filter cake twice as fast as tap water flow through the filter cake is considered potentially incompatible.

Phase 2 Testing – Results

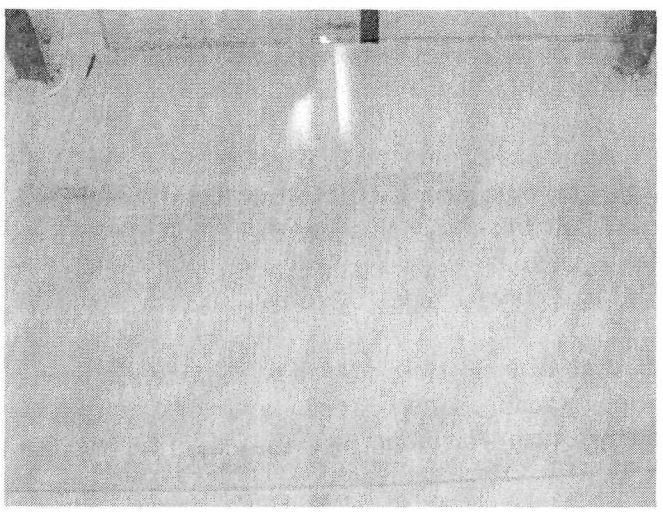
The results of the sedimentation tests are shown in the photographs below.



Sedimentation Test Results:
Left Picture – SR Bentonite, Right Picture – Bentonite
(tap water at left and groundwater at right in each picture)

There was no indication of any sedimentation or flocculation with either bentonite due to the groundwater. Some bleed was observed with both the tap water and groundwater in the test with the API bentonite, but the amount of bleed was equal in both tests. Based on these results, neither bentonite product demonstrates a gross incompatibility with the groundwater.

The results of the chemical desiccation test are shown in the picture below:

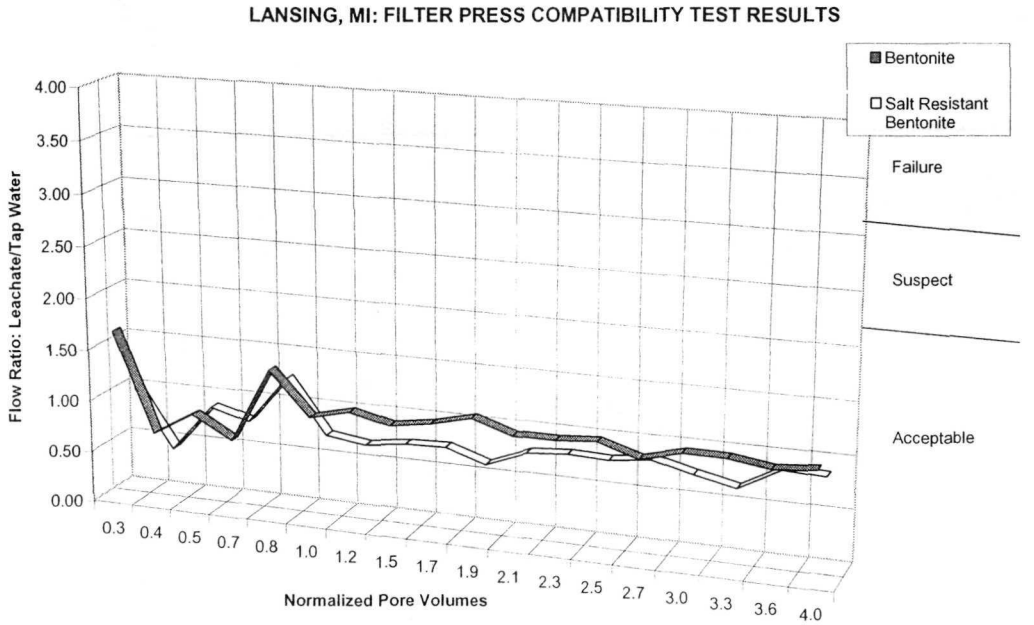


Chemical Desiccation Test Results:

Left Side - SR Bentonite, Right Side – Bentonite
(tap water at top, groundwater at bottom in each picture)

There is no cracking or other indications of chemical desiccation in any of the tests. Both clays performed similarly with the tap water and the groundwater. Based on these results, neither bentonite product demonstrates a gross incompatibility with the groundwater.

The results of the modified filter press test are presented in the graph, below.



	0.3	0.4	0.5	0.7	0.8	1.0	1.2	1.5	1.7	1.9	2.1	2.3	2.5	2.7	3.0	3.3	3.6	4.0
Bentonite	1.67	0.70	0.93	0.72	1.44	1.03	1.12	1.03	1.09	1.19	1.06	1.06	1.10	0.98	1.07	1.07	1.02	1.05
Salt Resistant Bentonite	1.00	0.43	0.89	0.79	1.25	0.74	0.68	0.74	0.75	0.63	0.78	0.81	0.80	0.85	0.75	0.67	0.88	0.87

The ratio of flow with groundwater and tap water is about 1.0 for both clays. The results are similar and acceptable for both clays. Based on these results, neither bentonite product demonstrates a gross incompatibility with the groundwater.

Based on the results of the three compatibility tests, both bentonites are compatible with the groundwater and either bentonite could be used in Phase 4. Based on common usage and cost considerations, the API-type bentonite is recommended for testing in Phase 4 testing.

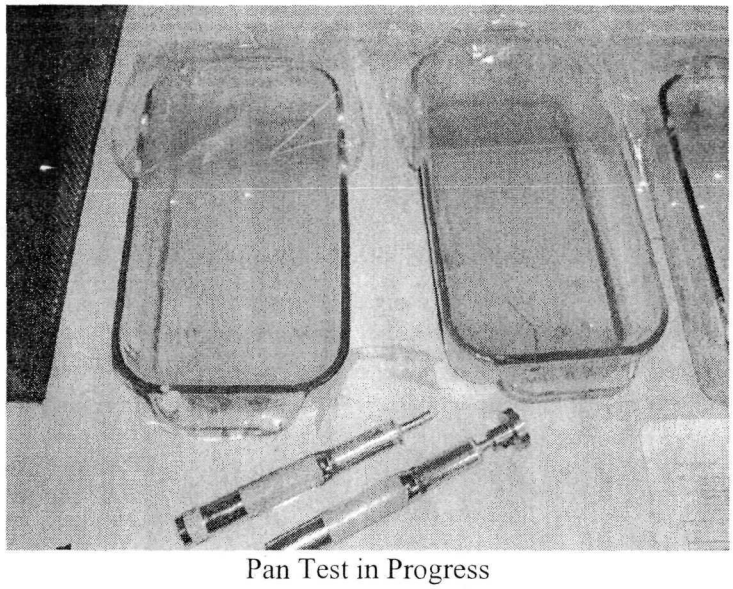
Phase 3 Testing – Grout Compatibility via Index Tests

Index-type compatibility tests are being performed with cement grouts to detect potential incompatibilities or reaction between the grouts and site groundwater. Two different grouts were formulated and are being tested. The proportions and properties of the grouts are shown in the table below.

Trial Mix No.	REAGENT TYPE	REAGENT/WATER (%)	Apparent Viscosity (cP)	Grout Density (pcf)
CB	PC/Bentonite	0.2 / 0.025	2,5	71.0
IMP	BFS/ Attapugite	0.12 / 0.06	2.5	69.0

The grouts are workable and could be mixed with soil to create SCB with minor modifications.

Two compatibility tests are being performed on the grouts. In the Pan test, the fluid grout is poured into a pan filled with either groundwater or tap water. The grouts are tested for penetration resistance as they set and harden under the waters to detect any observable differences in the setting process due to the different waters. These tests have begun and are still in progress. A picture of one test is shown below.



Pan Test in Progress

In the Slake test, hardened cylinders of grout are immersed in groundwater and tap water. The cylinders are observed for at least 2 weeks, then removed and cut into sections to detect any changes due to immersion in the different waters. The samples have been made for these tests and are curing prior to testing.

Phase 3 Testing – Results

At this time no results are available from the pan test or slake test. Compatibility testing with the grout mixtures will continue until complete. It is premature to formulate and test SCB mixtures, at this time.

Based on the available results, we plan to begin Phase 4 testing with bentonite clay and will only return to SCB mixtures if unusual or unsatisfactory results are obtained with SB.

Phase 4 – Soil-Bentonite Design Mixtures

Based on results obtained to date, SB mixtures should include API-type bentonite, composite soils and EHLN borrow soil. Bentonite slurry will be added to the mixture to produce acceptable workability (measured as slump) and further increase the proportion of bentonite in the mixture. Given the limited fines in the expected trench spoils (see Composite soil fines above) we estimated the minimum mixture ratio to be 2 parts of the trench spoil to 1 part of the EHLN borrow soil. In the worst case (SD-2), this should result in a fines content of 25% which is generally adequate for SB backfill. We will also plan to test a mixture ratio of 1:1, which may result in a lesser bentonite requirement. Mixture SB5 (with a 1: 1 ratio) is similar to the SB backfill produced for the Former Acid Sediment Drying Area project in 2006. Adding more bentonite and/or EHLN borrow to any mixture should improve impermeability. The mixtures to be tested are shown in the table below.

Mix No.	Mixture Ratio Composite : EHLN	Dry Bentonite Added (%)	Slurry Bentonite Added (%)
SB1	2:1	0.00%	?
SB2	2:1	1.50%	?
SB3	2:1	3.00%	?
SB4	1:1	0.00%	?
SB5	1:1	1.50%	?

It is expected that the addition of bentonite slurry to create workable SB mixtures with a slump of 4 to 6 inches and will add about 1 to 2% bentonite to the mixtures. The actual amount of bentonite amount added will be measured. These mixtures will be tested in a flexible wall permeameter at an effective confining stress of 10 psi and a gradient of less than 30 with tap water as the permeant. We plan to start making mixtures this week.

Please feel free to call me anytime.

Steve

SOIL-BENTONITE DESIGN MIXTURE

Memorandum from Geo-Solutions

Date: 3/29/07
To: Jon Nickel, Asarco,
Russ Morgan, Elaine Coombe, Shaw
From: Steve Day, Geo-Solutions
Via: email

Subject: Permeability Testing for Slurry Cutoff Wall, Speiss/ Dross Site, East Helena, MT

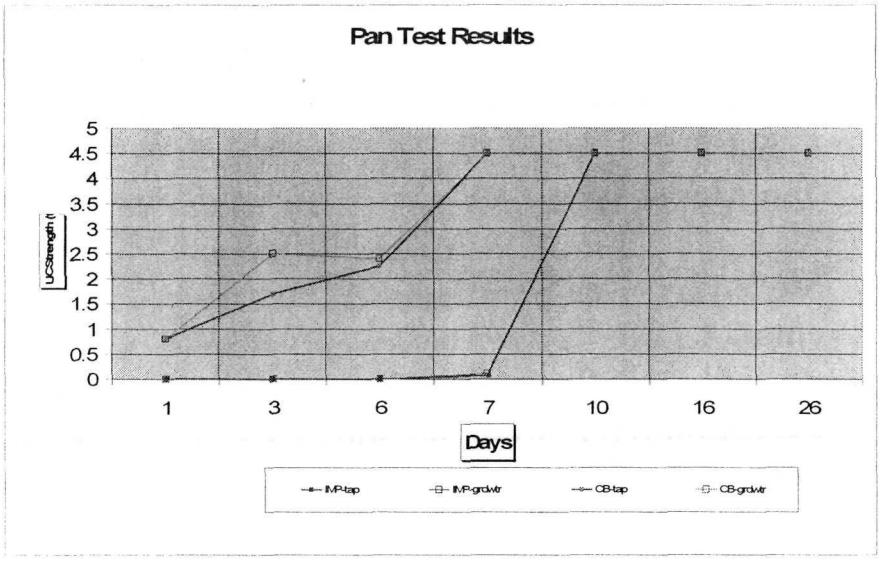
Jon:

This is the second in a series of memos to report to you on the progress of our efforts to complete a laboratory design mix program to develop a compatible and low permeability mixture of materials to serve as the backfill for a slurry wall at the Speiss/Dross Site in East Helena, MT.

Our previous memo concentrated on compatibility testing with the site groundwater and bentonite clay. Compatibility test results with bentonite were very good and no incompatibilities were noted. This memo includes initial compatibility results with grouts for soil-cement-bentonite (SCB) backfill and permeability test results with soil-bentonite (SB) trial backfill mixtures.

Phase 3 - SCB Compatibility Results

Two tests are being performed on cement grouts with the Site groundwater. The grouts are a mixture a Portland cement and bentonite in water (CB) and a mixture of slag cement and attapulgite clay in water (IMP). The Pan test results are now available. The Slake test results are still in progress. In the Pan test, the fluid grout is poured into a pan filled with either groundwater or tap water. The grouts are tested for penetration resistance as they set and harden under the waters to detect any observable differences in the setting process due to the different waters. A chart portraying the Pan test results are shown below.



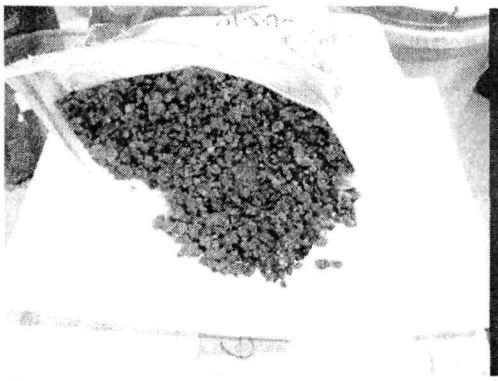
There is no difference in the results with IMP grout and a negligible difference in results with the CB grout. Based on the Pan test result, there is no detectable incompatibility with the cement grouts.

Due to the success in the bentonite compatibility tests and initial SB permeability testing (see below), we recommend stopping the further SCB testing, except for completing the on going slake tests. If, at some later date, we find a need to continue with SCB testing, this could be done with minimal delay.

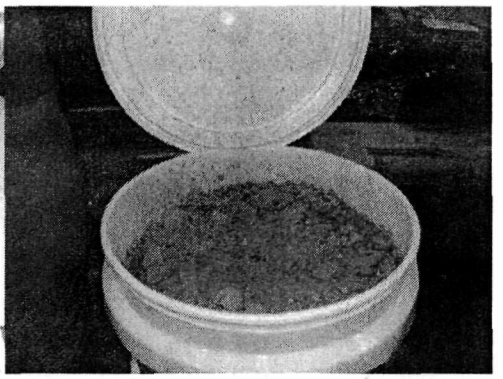
Phase 4 – Soil-Bentonite Design Mixtures

Based on the previous results, five SB mixtures were formulated for testing with API-type bentonite clay. The trial SB backfill mixtures were made from native soils gathered in soil borings (composite), borrow soils available near the Site known as EHLN, and bentonite clay. Bentonite clay was incorporated into trial SB mixtures from dry bentonite powder and bentonite slurry.

The composites were made from soils obtained in exploratory borings and EHLN, a source of fines (materials smaller than 0.075 mm), that were sampled and sent to the laboratory by ASARCO. All rocks greater than 0.5 inch were excluded from the composites to permit accurate laboratory testing with reasonable sample sizes in accordance with ASTM standards. Volcanic tuft, a fine material that will serve as the foundation (or key) for the slurry trench, was excluded from the composites to provide a degree of conservatism. Groundwater was added to the composite soils to restore them to a natural moisture content of 10%. Upper lake water was added to the EHLN soils to restore them to a moisture content of 15%. A picture of the composite and EHLN soils are shown below.



Composite Soils



EHLN Soils

The SB mixtures were made by mixing the composites and EHLN soils in two proportions (2:1 and 1:1 by weight) and then blending in the desired amounts dry bentonite and slurry bentonite. Slurry bentonite was added to the soils until a slump of 4 to 6 inches was recorded. The proportions and properties of the mixtures are listed below.

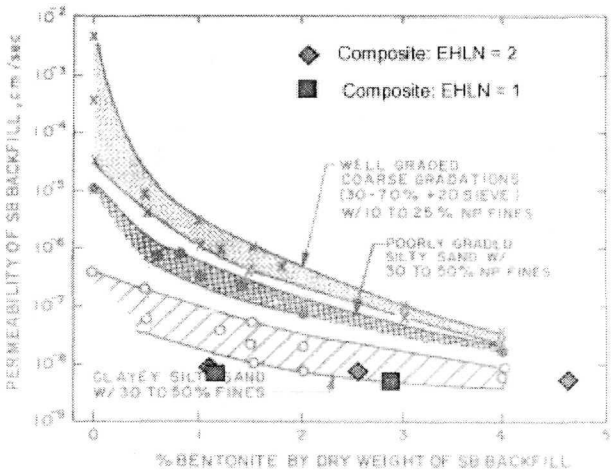
Mix No.	Soils	Dry Bentonite Added (%)	Slurry Bentonite Added (%)	Total Bentonite Added (%)	Water Content (%)	Density (pcf)
1	1: EHLN + 2: Composite	0.0	1.0	1.0	27	120
2	1: EHLN + 2: Composite	1.5	1.1	2.6	28	120
3	1: EHLN + 2: Composite	3.0	3.0	1.7	32	112
4	1: EHLN + 1: Composite	0.0	1.1	1.1	36	116
5	1: EHLN + 1: Composite	1.5	1.4	2.9	37	119

In general, the mixture of EHLN and composite soils with bentonite produced an excellent slurry wall mixture. The properties of the mixtures are typical of SB backfills.

The SB mixtures were tested for fines content and permeability. Samples of the mixtures were tested in flexible wall permeameters and at an effective stress of 10 psi and a hydraulic gradient less than 30 in accordance with ASTM D5084, Method D (flow pump). The preliminary results of our tests are shown in the table below.

Mix No.	Fines (%<#200)	Permeability (cm/sec)
1	25	1.5×10^{-8}
2	26	1.3×10^{-8}
3	36	5.7×10^{-9}
4	30	9.3×10^{-9}
5	32	8.5×10^{-9}

All of the mixtures easily meet the standard of less than 1×10^{-7} cm/sec. These results must be considered preliminary until final dimensional measurements are complete (and test specimens are disassembled). The results of the tests on mixtures 1 through 5 are portrayed in the graph below[1].



From the graph it seems apparent that the proportion of EHLN and amount of bentonite makes little difference at the ratios tested. Therefore, the most economical mixture, SB-1 with 1% bentonite and a Composite : EHLN proportion of 2:1, can be selected for long term testing.

Phase 5 – Long Term Permeability Testing

At this time it is appropriate to move to Phase 5 of the testing program and subject one SB mixture to long term testing with the site groundwater. Therefore, we propose to subject mixture SB-1 to long term permeability testing with the site groundwater until two pore volumes are groundwater are forced through the test specimen.

[1] D'Appolonia, D.J., "Soil-Bentonite Slurry Trench Cutoffs", *Journal of the Geotechnical Engineering Division,* American Society of Civil Engineering, Vol. 106, No. GT4, April 1980.

Based on the current value of permeability and a gradient of 30 (as per ASTM D7100), we calculate a testing period of more than 250 days, which is excessive and unnecessary. Therefore, in order to expedite the testing, we will increase the hydraulic gradient to about 65 in order to complete the testing in about 100 days. In accordance with D'Arcy's law of permeability and established engineering procedures, the increased gradient should be irrelevant in our results.

Please feel free to call me anytime.

Steve

LONG TERM PERMEABILITY TESTING

Memorandum from Geo-Solutions

Date: 4/12/07
To: Jon Nickel, Asarco,
Russ Morgan, Elaine Coombe, Shaw
From: Steve Day, Geo-Solutions
Via: email

Subject: Long Term Permeability Testing for Slurry Cutoff Wall, Speiss/ Dross Site, East Helena, MT

Jon:

This is our third in a series of memos to report to you on the progress of our efforts to complete a laboratory design mix program to develop a compatible and low permeability mixture of materials to serve as the backfill for a slurry wall at the Speiss/Dross Site in East Helena, MT.

This memo presents on-going, long-term, SB permeability test results. Please note that all test results must be considered to be preliminary until the samples are dismantled and measured.

Phase 4: Soil-Bentonite Backfill Trial Mixtures

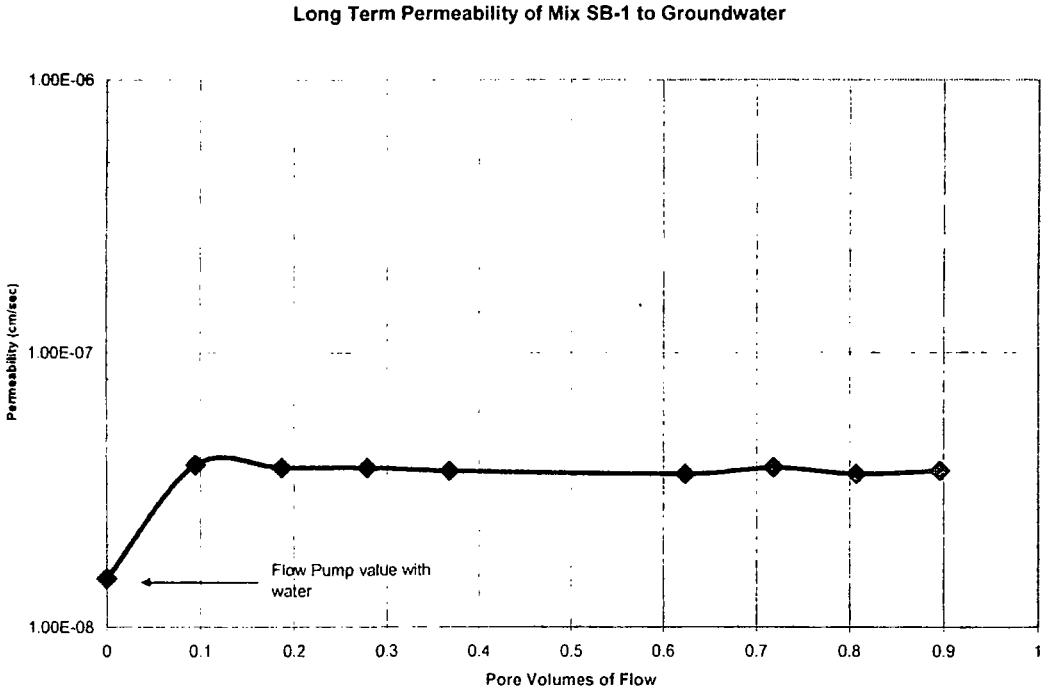
As you may recall, we made 5 SB mixtures by mixing exploratory boring composites soils with EHLN soils in two proportions and then blending in the desired amounts dry bentonite and slurry bentonite. All of the samples passed our goal of achieving a permeability of less than 1 x 10^{-7} cm/sec. The basic proportions and properties of the mixtures are summarized below.

Mix No.	Mixture Ratio Comp: EHLN	Fines Content (%)	Total Bentonite Added (%)	Permeability (cm/sec)
SB1	2:1	25	1	1.5E-08
SB2	2:1	26	2.6	1.3E-08
SB3	2:1	36	4.7	5.7E-09
SB4	1:1	30	1.1	9.3E-09
SB5	1:1	32	2.9	8.5E-09

The SB samples were permeated with water in flexible wall permeameters and at an effective stress of 10 psi and a hydraulic gradient less than 30 in accordance with ASTM D5084, Method D (flow pump). Based on these results we selected SB1 for long term permeation with the groundwater.

Phase 5 – Long Term Permeability Testing

The long term test is planned to subject mixture SB1 to testing with the site groundwater until two pore volumes are groundwater are forced through the test specimen. Based on the initial value of permeability for SB1, and in accordance with ASTM D7100, we selected a hydraulic gradient to about 65 with the same confining pressure for the long term test. The test results obtained thus far are shown in the table below.



As can be seen in the chart, the value of permeability, thus far, is steady at about 4×10^{-8} cm/sec, which is again, well below our goal of 1×10^{-7} cm/sec. There was a minor initial increase in permeability that resulted from changing test conditions and permeate, but after the initial change, the permeability of SB1 has been steady. The test continues with the goal of passing at least 2 pore volumes of groundwater through the sample. To date our results look very encouraging for demonstrating a low permeability, long-term, compatible result.

Please feel free to call me anytime.

Steve

Issued by:
Denver Office: 26 W. Dry Creek Circle, Suite 600, Littleton, CO 80120, Ph: 720-283-0505, Fax: 720-283-8055.
Check out our web site at www.geo-solutions.com

APPENDIX F

CONSTRUCTION QUALITY CONTROL PLAN

Construction Quality Control Plan

Former Speiss-Dross Plant Area Slurry Wall

Asarco Smelter Facility
East Helena, MT

Shaw E&I Project No.125406

April 2007

Shaw™ Shaw E & I

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

ABBREVIATIONS AND ACRONYMS

Asarco	ASARCO, LLC
CQCP	Construction Quality Control Plan
DQCR	Daily Quality Control Report
EPA	U.S. Environmental Protection Agency
FADL	Field Activity Daily Log
MDEQ	Montana Department of Environmental Quality
NCR	Nonconformance Report
PM	Project Manager
QA	quality assurance
QC	quality control
QCM	Quality Control Manager
Shaw	Shaw Environmental & Infrastructure, Inc.
SSHO	Site Safety and Health Officer

CONSTRUCTION QUALITY CONTROL PLAN
FORMER SPEISS-DROSS PLANT AREA SLURRY WALL

1.0 INTRODUCTION

This Construction Quality Control Plan (CQCP) describes quality control (QC) procedures for constructing a slurry wall within the former Speiss-Dross Plant area at the Asarco Smelter Facility, East Helena, Montana.

1.1 Quality Control Objective

The goal of this CQCP is to ensure that the required slurry wall construction activities will be completed as stated in the design documents. Documentation shall be prepared and maintained during and after the completion of slurry wall construction activities so that it can be demonstrated that work has been completed and performance requirements of the plans have been met.

1.2 Construction Quality Control Plan

This CQCP is designed to define the methodology and practices to control the quality of work performed during the construction of the slurry wall. At a minimum, this CQCP addresses the QC procedures for:

- The organization, responsibilities, and authority for personnel performing QC-related functions;
- The project QC system;
- Inspections and tests;
- Sampling and analyses (if needed);
- Document control/records management;
- Nonconformance's and corrective actions;
- Subcontractor control;
- Change control, and
- Audits and surveillance.

The Contractor's Quality Control Manager (QCM) or designee shall be responsible for implementation of and control of the QC program during site preparation, excavation, debris removal, site closure, and any other work affected by the QC program.

This CQCP establishes measures for controlling items or activities affecting quality and for verifying compliance with the specified requirements of the contract. Methods utilized to achieve the goals of the CQCP include but are not limited to:

- Project planning;
- QC inspection;
- Document/record controls;

- Nonconforming conditions/deficiency corrective actions;
- Completion inspections;
- Subcontractor controls;
- Audits and surveillance;
- Calibration program, and
- Use of standard quality assurance/quality control (QA/QC) forms.

2.0 BACKGROUND

The Asarco Smelter Facility covers 8.4 square miles near East Helena, Montana. The Asarco Smelter Facility is located near the intersection of U.S. Highway 12 East and South 1st Street in East Helena. The Asarco Smelter Facility includes a lead smelter that operated from 1888 until 2001.

The slurry wall shall be installed as a continuous wall system utilizing soil-bentonite (SB) slurry to stabilize the trench walls. The intended location of the slurry wall is at the former Speiss-Dross Plant area located in the central portion of the Asarco Smelter Facility.

The objectives of this project are as follows:

- Construct the slurry wall to encompass the former Speiss-Dross Plant area;
- Restore the site; and
- Prepare a final construction report.

3.0 QUALITY CONTROL ORGANIZATION

ASARCO LLC (Asarco) will interface with the Environmental Protection Agency (EPA) and Montana Department of Environmental Quality (MDEQ), as necessary.

3.1 Quality Control Organization

The following sections describe the roles, responsibilities, and authorities of key project personnel performing activities that affect project quality.

3.1.1 Project Manager

The Contractor's Project Manager (PM) shall interface directly with Asarco regarding project execution and accountability and be the primary point of contact for the contract. The PM controls the budget and schedule ensuring that contract requirements are met. The PM shall be responsible for managing construction activities, including subcontractors. The PM shall be responsible for ensuring overall conformance of the work to project and contract requirements and specifications including technical, cost, and schedule requirements. The PM shall organize the assigned project staff and initiate project planning and implementation activities.

3.1.2 Construction Site Manager

The Contractor's Construction Site Manager (CSM) shall be responsible for the onsite management and execution of all field project activities in accordance with the Work Plan and federal, state, and local laws and regulations. The CSM shall function as the primary point of contact for onsite Asarco, field personnel, and subcontractors. The Construction Site Manager shall advise the PM of technical progress, expenditures, project needs, potential problems, and recommended solutions. The CSM shall be a Construction Specialist fully dedicated to, experience in and capable of supervising the construction of, slurry preparation, slurry backfill preparation and placement, and quality control monitoring and documentation for the soil-bentonite slurry wall.

3.1.3 Quality Control Manager

The Contractor's QCM shall report directly to the PM on all matters within the scope of the project QC program. The QCM shall be responsible for the overall management of the QC program on site and off site, including field installation activities and consulting engineering activities for the project.

Duties of the QCM include but are not limited to the following:

- Implementing the project CQCP;
- Initiating or recommending corrective actions;
- Verifying the implementation of corrective actions;
- Continuously evaluating the effectiveness of the project CQCP;
- Notifying the PM of conditions adverse to quality that cannot be resolved at the project level;
- Monitoring operation activities for compliance with contract requirements;
- Monitoring laboratory testing activities;
- Identifying and reporting nonconforming items, conditions, or activities;
- Monitoring onsite subcontractors;
- Preparing QC reports if required by the contract;
- Performing and documenting installation inspection activities, and
- Performing or monitoring sampling activities.

3.1.4 Slurry Wall Specialist

The Slurry Wall Specialist will report directly to the QCM. The Slurry Wall Specialist shall be fully dedicated to, experience in and capable of supervising the construction of, slurry preparation, slurry backfill preparation and placement, and quality control monitoring and documentation for the soil-bentonite slurry wall. The Slurry Wall Specialist shall be on site at all times when slurry, and/or slurry backfill are being mixed or installed in the slurry wall. Adjustments to the slurry mix and SB backfill will be made under the direction of the Slurry Wall Specialists.

3.1.5 Subcontractors

When other companies and/or subcontractors are involved in performing activities governed by the requirements of the CQCP, the responsibility and authority of such organizations shall be clearly established and documented. Although the Contractor may delegate the work of establishing and executing certain portions of the CQCP, the Contractor shall retain responsibility for fulfilling the QC program.

3.1.6 Site-Specific QA/QC Control Training

The QCM (or designee) shall be responsible for providing basic training of all project personnel performing quality-related activities. The training shall include a review of the project CQCP, work plans, regulatory requirements, and other project-specific documents necessary for personnel to perform project work activities properly.

3.1.7 Changes of QA/QC Personnel

The Contractor shall strive to maintain continuity of QA/QC personnel on the project. In the event that personnel changes become necessary, Asarco shall be notified and approval received for any proposed change.

4.0 QC INSPECTIONS

QC inspections shall be conducted to ensure that project tasks are performed per the design documents. A final inspection shall be formally scheduled and completed for the entire project. Each type of anticipated inspection is discussed in the following paragraphs. Completed inspection forms and a log will be maintained in the site QC files and will be available for review at any time.

4.1 Preparatory Inspections

Pre-construction meeting shall be performed before the execution of field work. The pre-construction meeting will be attended by the CSM, the Site Safety and Health Officer (SSHO), CQM, Slurry Wall Specialist, and subcontractors (as appropriate). The pre-construction meeting shall include:

- Reviewing contract plans;
- Reviewing pertinent contract design plans (i.e., specifications and drawings);
- Reviewing materials and equipment documentation for required tests, submittals, and approvals;
- Reviewing required control inspections and test requirements;
- Establishing that the preliminary work required to begin the task is complete and conforms to approved drawings and submittal data;
- Establishing that the required materials and equipment for commencement of the work are on hand or available for use on the task;

- Confirming that materials and equipment conform to the specifications and that all equipment is properly calibrated and in proper working condition;
- Discussing procedures for performing the work; and
- Reviewing the appropriate activity hazard analysis.

Personnel performing work activities affected by a preparatory inspection shall be instructed as to how to complete the task so that their workmanship is in compliance with QC requirements.

4.2 Initial and Follow Up Inspections

Additional inspections shall be conducted at the start of the project and on a continuous basis to ensure continuing compliance with contract requirements. The frequency of the inspections shall depend upon the extent of work being performed. The inspection shall be conducted to evaluate the following criteria:

- Verification of preliminary work;
- Compliance with the specifications, drawings, submittals, and other contract requirements;
- Compliance with the Asarco and Contractor's Site-Specific Health and Safety Plans;
- Acceptable quality of workmanship, and
- Resolution of any differences.

4.3 Equipment Inspections

Equipment shall be inspected and calibrated according to manufacturer's requirements before field use. Inspection of heavy installation equipment shall be recorded daily. All equipment inspections and calibrations shall be conducted by personnel with specific training and experience in the operation of that equipment.

4.4 Installation Contingency Procedures

Changes to the design plans and/or specifications may be required during installation to address unforeseen situations encountered in the field. In the event that a change to the approved plans is necessary, the CSM shall stop work and notify the PM of the change. The PM shall immediately provide formal oral notification to Asarco. Upon approval of the change by Asarco, installation activities will continue. PM shall submit written notification/documentation of the approved change within 48 hours of verbal approval by Asarco.

In the event that an emergency condition such as a fire or earthwork failure arises, notifications shall initially be completed orally via telephone and documented later. Emergency notifications to all concerned parties may be made simultaneously, if applicable.

4.5 Substantially Complete and Final Inspections

The Contractor shall conduct substantially complete and final inspections to verify that the work performed meets the requirements of plans, specifications, quality, workmanship, and

completeness. The substantially complete and final inspection shall be attended by representatives of Asarco and subcontractors (if applicable).

A substantially complete inspection shall be conducted at the completion of all work to verify compliance with the contract plans and requirements. During the substantially complete inspection, a punch list of items not conforming to the specified requirements, including incomplete project items, shall be developed.

Upon completion/correction of the punch list items, a final inspection shall be conducted to verify that completed work conforms to the contract requirements. The notice of a final inspection shall include assurance that all punch list items previously identified will be completed by the date scheduled for the final inspection. Asarco will sign-off on the final inspection to concur that the site was returned to contractually required conditions.

4.6 Safety Inspections

The SSHO shall perform daily safety inspections and daily tailgate safety meetings throughout the project. The inspections and meetings will be reported on daily logs. The inspection and meeting attendance form shall be maintained in the project files.

4.7 Field Inspections

Field inspections are primarily visual examinations, but may include measurements of materials and equipment being used, techniques employed, and the final products. These inspections shall confirm that a specific guideline, specification, or procedure for the activity has been successfully completed. These inspections shall be performed either during remediation and/or construction work activities or shortly after completion of the work by the QCM. The results shall be documented on daily logs.

4.8 Field Tests

Field tests are tests or analyses made in connection with site activities. Field tests shall be performed primarily on the slurry during the preparation of the slurry, monitoring of the slurry, and degradation of the slurry. The Slurry Wall Specialist shall conduct and document these filed tests. The results of the field tests shall be documented daily and submitted on a daily basis to Asarco for review and approval.

4.9 Surveys

Surveys include the establishment of horizontal and/or vertical grade control for installation, establishment of an elevation benchmark, reference/location surveys for structures, and topography, as appropriate and reviewed by the QCM.

4.10 Review of Manufacturers' Certificates of Compliance

Certificates of Compliance shall be obtained from suppliers for selected materials. The certificates shall be reviewed/approved by the QCM prior to material delivery. Certificates shall

include a statement that the material meets all the specification requirements, and supporting test results shall also be provided.

4.11 Inspection Checklists

Inspection checklists shall be required for all definable features of work and shall document inspection results. The checklists will be maintained by the QCM and be attached to the daily logs.

5.0 DOCUMENT CONTROL

This CQCP establishes the document control system that provides measures for controlling the issuance, distribution, storage, and maintenance of documents relating to quality, including those of subcontractors and other vendors.

5.1 Field Activity Daily Log

Daily logs shall be completed to document all project activities. The daily log shall cover both conforming and nonconforming work and, where applicable, shall include a statement of certification that all materials, supplies, and work comply with the contract requirements. The daily log will include:

- Location and type of work;
- Type and number of control activities;
- Results of inspections and tests;
- Types of defects/causes for rejection, if any;
- Corrective actions proposed/taken, if any;
- Trades/personnel working – type and number;
- Weather conditions;
- Delays and their causes, if any;
- Verbal instructions;
- Samples collected;
- Field analyses performed, including results;
- Calibration procedures and readings;
- Health and safety activities;
- Equipment used;
- Equipment daily check list;
- Nonconformance reports, deficiency reports, and records of statement of work clarifications;
- Remarks, and
- Certifications.

Additional documentation (e.g., test reports, subcontractor daily reports, and other pertinent documentation) may be included as attachments to the daily log.

5.2 Project Records

QC records shall be prepared to furnish documented evidence that project activities, including laboratory analyses, fulfill the scope of work and are in compliance with the requirements of the contract. Records shall be maintained and stored at the project site. Records shall be readily retrievable for review and audit purposes by Asarco. The records shall be controlled in order to avoid the possibility of their loss or damage. The records shall be consistent with the applicable sections of the contract specifications and may include:

- Inspection reports;
- Monitoring and surveillance activities;
- Personnel qualifications;
- Corrective actions;
- Training records, and
- Other specified documents.

5.3 Inspection Documentation

The QCM is responsible for the maintenance of the inspection records. Inspection records shall be legible and shall clearly provide all information necessary to verify that the items or activities inspected conform to the specified requirements. In the case of nonconforming conditions, inspection records shall provide evidence that the conditions were brought into conformance or otherwise accepted by Asarco.

6.0 NOTIFICATION OF NONCONFORMANCES

This section describes the procedures for controlling items that do not conform to specified design requirements by tracking them from identification through acceptable corrective action. All personnel are responsible for identifying deficiencies and notifying the QCM.

6.1 Identifying Deficiencies

The QCM shall be notified of all deficiencies identified during the course of site activities to ensure that each deficiency is documented, reported, and tracked, that corrective actions are taken, and that follow-up verification is conducted.

The QCM shall include the identified deficiencies in the daily log, noting the item found to be deficient, date, time, location, the person who identified the deficiency, and the status of the item to which the deficiency applies (installed, awaiting installation, deficiency identified upon receipt, item previously accepted but in storage, etc.). The QMC shall also include what action is being performed to correct the deficiency.

6.2 Punch Lists

Substantially complete inspections conducted by the QCM typically result in the development of a punch list of items that do not conform to approved plans. During the course of each substantially complete inspection, the QCM shall document nonconforming items in a punch list that will serve as input to the QCM database for items requiring corrective action. The database will serve as the tracking system for the follow up of open items and will identify when they are completed.

The QCM shall monitor the punch list corrective action database on a daily basis until all corrective actions have been completed and the punch list is closed out. A printout of database open items shall be included with and attached to the daily log.

6.3 Notification

Asarco will be notified of the identification and progress toward resolution of nonconforming items/conditions through the reporting requirements stated in the project procedures and/or plans or through attendance at coordination meetings.

7.0 TESTING

This section describes the controls to be implemented for the performance of tests required to verify the acceptability of the slurry wall construction activities. The testing shall include onsite field tests for the preparation of the slurry mix.

7.1 Slurry

Onsite field tests shall be conducted to verify that the materials (e.g., water) and slurry mixture meets the requirements listed in Table 1. The slurry shall be adjusted accordingly if the mixture does not meet the requirements for the three phases.

7.2 Site Soil and Water Sampling

Soil and groundwater sampling activities will not be conducted during the construction of the slurry wall.

7.3 Air Monitoring

Air monitoring shall be conducted to monitor dust emissions and the effectiveness of dust control techniques during soil excavation and placement. The SSHO shall select the air monitoring location(s) based on anticipated work activities, site contaminants, and wind direction.

8.0 FIELD QUALITY CONTROL

The field control component of the CQCP includes:

- Procedures for documenting and justifying any field actions contrary to the CQCP;
- Documentation of all pre-field activities such as equipment checkout, calibrations, and manufacturer inspections;
- Documentation of field inspection activities during the project; and
- Documentation of field measurement QC data.

8.1 Field Changes to Quality Control Plan

Changes to the CQCP procedures, testing requirements, or personnel may be required to adjust for unforeseen circumstances. Changes may be required in the event that the given procedures do not provide adequate control, or may be proactively initiated by the Contractor to ensure that QC objectives are met.

Should modifications to this CQCP become necessary or desirable; the Contractor shall notify Asarco in writing. The notification shall include a description of the proposed change, the reason(s) for requesting the change, and the date upon which the change needs to become effective, along with other pertinent information.

8.2 Pre-Field Activities

Pre-field activities include calibrating equipment, performing preparation inspections, obtaining field permits, and obtaining a copy of the manufacturer inspection documents for materials to be incorporated into the project.

8.2.1 Field Equipment Calibrations and Inspections

Equipment shall be inspected and calibrated according to manufacturer's requirements before field use. Inspection of heavy installation equipment will be recorded daily. Calibration of field testing equipment shall be recorded on equipment calibration forms. All equipment inspections and calibrations shall be conducted by personnel with specific training and experience in the operation of that equipment. These forms shall be attached to the daily log and shall be submitted on a daily basis.

8.2.2 Field Permits

The Contractor will coordinate through Asarco to obtain any required permits, before beginning construction activities.

8.3 Field Measurement Quality Control

Field measurements will generate substantial quantities of data. Field measurement data results for the slurry shall be included on the DQCR. Copies of completed DQCRs will be turned into Asarco as soon as the results are available.

8.4 Inspection of Field Activities

Field activities shall be inspected at least on a daily basis. The Contractor shall make daily inspections of all work in progress, recording all deficiencies in the field log along with a notation of the corrective action taken. All other inspection activities shall also be reported in the field log.

8.5 Subcontractor Direction

Activities of subcontractors shall be under the direction of the CSM. Inspections of all subcontractor work, including inspections, shall be conducted by the QCM.

9.0 SUBCONTRACTOR CONTROL

All subcontractors performing work for the project are responsible for conformance to the quality requirements of their respective subcontract. Subcontractors include organizations supplying quality-related items or services to the project. The overall responsibility for conformance to the quality requirements for the subcontracted items and services is retained by the Contractor.

The requirements for personnel qualifications, technical performance levels, QC procedures, acceptability levels, and documentation shall be included as a part of the subcontract documents.

The QCM is responsible for the implementation of inspections, document reviews, audits, and other QC activities used to monitor the subcontractor's compliance with the contract. These activities shall be documented on checklists, field logs, or other forms appropriate to the function performed.

For field operations, the Contractor shall provide QC checks before, during, and after the completion of the subcontractor's activities. The QC checks shall include preparatory, initial, follow-up, and final inspections to determine if the subcontractor is in compliance with the QC measures set forth by the contract and the applicable subcontract responsibilities including:

- Meeting quality requirements;
- Generating, controlling, and maintaining required documentation;
- Performing and documenting required inspections and tests;
- Identifying, reporting, and correcting nonconforming conditions, and
- Timely submittal of documentation to Shaw.

9.1 Subcontractor QA/QC Responsibilities

Subcontractors performing work shall be monitored by the Contractor to verify conformance to the contract and subcontract quality requirements. The monitoring activities shall include inspections. All monitoring activities shall be documented on the appropriate form or included in the daily logs. Subcontractors shall be required to provide documentation consistent with project requirements.

9.2 Subcontractor Nonconformance

Work performed by subcontractors that does not comply with the specified requirements shall be identified, reported, corrected, and tracked in accordance with this CQCP.

9.2.1 Notification of Nonconformance

Notification of subcontractor noncompliance shall be accomplished via a Nonconformance Report (NCR), with copies kept in the QC files.

9.2.2 Corrective Actions

Corrective actions by subcontractors will be monitored by the QCM or designee to verify that the subcontractor's performance meets the required specifications.

Table 1: Soil - Bentonite Slurry Trench Quality Control Testing Plan

Property	Requirement	Min. Test Frequency	Test Method	Comment
Bentonite Powder				
a. Certification	API 13A	1 per truck or lot	--	Manufactures Certification
Water for Slurry Mixing				
a. pH	6 to 9	1 per source	API RP 13B-1	May be modified for
b. Hardness	< 500 ppm	1 per source	API RP 13B-1	potable source or if treated
Initial Bentonite Slurry				
a. Viscosity	> 40 seconds	2 per shift	API RP 13B-1	
b. Density	> 64 pcf	2 per shift	ASTM D-4380	
c. Filtrate Loss	< 25 cc	1 per truckload	API RP 13B-1	
d. Bentonite content	> 5%	1 per project	Weight-Volume	Demonstrate by proportion
e. pH of Slurry	6.5 to 10	1 per shift	API RP 13B-1	
In-Trench Bentonite Slurry				
a. Unit Weight	64 to 85 pcf	2 per shift	ASTM D-4380	Also > 15 pcf less than SB
b. Viscosity	> 40 seconds	2 per shift	API RP 13B-1	
SB Backfill Material				
a. Slump Cone	3 to 6 inches	1 per shift	ASTM C-143	
b. Gradation	Minimum 15% Fines	1 per shift	ASTM D-1140	Laboratory or Field Test
c. Density	15 pcf > In-trench slurry	1 per shift	ASTM C-138 or API RP 13B-1 D-4380 mod	
d. Bentonite content	> 1 %	1 per shift	Weight-Volume	
e. Permeability	< $1x10^{-7}$ cm/sec	1 per 500 cy	ASTM D-5084	Laboratory test

APPENDIX G

UTILITY DRAWINGS

NOTES:

1. THE FORMER SPEISS-DROSS PLANT AREA SLURRY WALL CONTRACTORS SHALL FLOW FILL THE PLANT RETURN WATER LINES AS NOTED ON THIS DRAWING.

2. (1) NOTE ADDED IN APRIL 2007 FOR FORMER SPEISS-DROSS PLANT AREA SLURRY WALL DESIGN.

NOTES:

1. USE FLOWABLE FILL OR PRESSURE GROUT TO PERMANENTLY ABANDON ALL UTILITIES SHOWN ON THIS SHEET.
2. ONLY FILL THE SECTIONS OF UTILITY LINES SHOWN. THIS MAY INVOLVE SEALING OFF CONNECTING UTILITY LINES.

LEGEND

- PLANT WATER (6")
- UPPER LAKE ACID PLANT WATER (24")
- PLANT RETURN WATER (Varies)
- SS — SEWER (6-10")
- ABND. WILSON DITCH (Varies)

NORTH

SCALE
(In Feet)
100 0 100 200 300

REVISIONS	NO	BY	DATE	DESCRIPTION
	1	JSD	040207	ADDED FLOW FILLED BY OTHERS

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Hydrometrics, Inc.
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Helena, Montana 59601
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ASARCO LLC - EAST HELENA PLANT
2007 CLEANING & DEMOLITION PROJECT
UNDERGROUND UTILITIES
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ASARCO INCORPORATED
EAST HELENA PLANT
2006 & 2007 DEMOLITION
UNDERGROUND UTILITIES

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603201H017.dwg
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